

Noise Assessment Report

Thames Quarter,
Reading

Prepared for
Lochailort Reading Limited

by

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Limited

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ACRONYMS AND ABBREVIATIONS

'A' weighted	'A' weighting is applied to the measured sound pressure levels so that these levels correspond more closely to the subjective response - expressed as dB(A)
BRE	Building Research Establishment
BS 5228	Code of practice for noise and vibration control on construction and open sites – Part 1: Noise (2009)
BS 8233	British Standard 8233 'Sound insulation and noise reduction for buildings – Code of practice' (2014)
CIRIA	Construction Industry Research and Information Association
CRTN	Calculation of Road Traffic Noise (1988)
°C	Degrees Celsius
dB	Decibel – unit of measurement of sound
EU	European Union
Hertz	Frequency oscillation in cycles per second i.e. 1000 Hertz is a thousand cycles per second
L _{Aeq,T}	'A' weighted equivalent continuous noise level over a time period, T
L _{Amax}	'A' weighted maximum noise level
LOAEL	lowest observed adverse effect level
ms-1	Metres per second
MVHR	Mechanical Ventilations and Heat Recovery
NPPF	National Planning Policy Framework (2012)
NPPG	National Planning Policy Guidance – Noise (2014)
NPSE	Noise Policy Statement for England
R _n	Receptor number, where 'n' is the number in reference to the CRTN calculations
RBC	Reading Borough Council
SLM	Sound Level Meter
SMA	Stuart Michael Associates Limited
SRI	Sound Reduction Index
UK	United Kingdom
UKAS	United Kingdom Accreditation Service in reference to sound level meter calibration
WHO	The World Health Organisation



Non-Technical Summary

The Noise Assessment (NA) considers the impacts and constraints from noise for the proposed Thames Quarter development. Proposals for the site are “erection of a part 13 storey, part 23 storey building comprising 338 apartments in a mix of studio, one-bedroom, two-bedroom and 3-bedroom units; residents’ lounges, tech-hub, dining room, and cinema room; various rooftop outdoor amenity spaces; concierge/reception with coffee meeting area; residents’ storage facilities; post room; ancillary back-of-house facilities; 338 secure cycle parking spaces; 49 car parking spaces; landscaping; and associated works”.

The report demonstrates that the proposed development generated traffic will not have a significant adverse noise impact on local sensitive receptors. It also demonstrates that the residential development will not be adversely affected by local noise sources. The dominant noise sources in the area are from road traffic on the local highway network, and from trains on the Great Western Main Line. The railway line is undergoing electrification, and once the project is complete, a significant proportion of trains will operate quieter than at present. However, the current GWR diesel trains have been measured and assessed in order to undertake a “worst-case” assessment.

A noise level survey was undertaken adjacent to the A329 Vastern Road, at the Coopers BMW access and on top of the car park adjacent to the railway line. To calculate the existing and future noise profile of the site the computer modelling programme SoundPLAN has been used. The impacts of development generated traffic have been assessed using modelled road traffic data for the local highway network and SoundPLAN. During construction the potential impact from activities within the site has been assessed using the “ABC” method described in BS 5228.

From the results of the field noise surveys and the computer modelling, noise levels within the development site are predicted to be above guidance levels and therefore a commensurate level of mitigation is required. The use of suitably glazed windows, and an appropriate alternative ventilation system, will ensure acceptable daytime and night-time internal noise levels. A 2 metre acoustic barrier on the southern boundary of the roof terraces is proposed to ensure that noise levels in this area are within guideline levels.



With regards to the impact of the development on local sensitive receptors, there is predicted to be a “Negligible” increase or “No Change” in noise levels at all of the façades included in the impact assessment. Noise from some construction activities will be audible at the nearest sensitive receptor locations, but if Best Practical Means (BPM) is implemented then noise impacts can be minimised.

Based on the results of the noise assessment, it has been concluded that with appropriate mitigation, internal and external noise levels meet the national and local standards and are acceptable for future residents of the proposed Thames Quarter development.



1.0 INTRODUCTION

- 1.1 Stuart Michael Associates Limited (SMA) has been engaged by Lochailort Reading Limited (the Applicant) to undertake a noise assessment for the proposed development Thames Quarter, Reading (refer to **Figure 1.1** for the site location). The site is located in the area administered by Reading Borough Council (RBC).
- 1.2 Proposals for the site are “erection of a part 13 storey, part 23 storey building comprising 338 apartments in a mix of studio, one-bedroom, two-bedroom and 3-bedroom units; residents’ lounges, tech-hub, dining room, and cinema room; various rooftop outdoor amenity spaces; concierge/reception with coffee meeting area; residents’ storage facilities; post room; ancillary back-of-house facilities; 338 secure cycle parking spaces; 49 car parking spaces; landscaping; and associated works”
- 1.3 This noise assessment demonstrates that the proposed development generated traffic will not have a significant adverse noise impact on local sensitive receptors. It also demonstrates that with appropriate mitigation the residential development will not be adversely affected by local noise sources.

Site Description

- 1.4 The site is to the north east of Reading Town Centre and was formerly occupied by Cooper BMW which comprised of the vehicle showroom and ancillary offices, a three storey car park and vehicle parking adjacent to King’s Meadow road. The showroom and offices have now been demolished, while the three storey car park has been retained. The site is bounded to the west by the A329 Vastern Road, to the north by King’s Meadow Road and to the south by the railway line (on embankment). There are existing commercial units to the east of the site.
- 1.5 To the south of the site lies the Great Western Main Line. This is currently undergoing electrification. Once complete, the line will operate with a significant proportion of electric trains which are significantly quieter than the current diesel trains operating on the line. At the time of writing this report it is anticipated that electric trains will start running on the line from 2019.



1.6 Vehicular access to the proposed development will be from King's Meadow Road and the existing site access. Wider vehicular access to the site is from the A329 Vastern Road, B3345 George Street (over Reading Bridge), A329 Forbury Road, the A329 Caversham Road and the A4155 Caversham Road.

1.7 Pedestrian access to the site will be from the A329 Vastern Road (town centre and the train station) and King's Meadow Road (from the north and east).

Assessment Methodology

1.8 Following consultation with RBC (cross reference the statement of pre-application consultation which was submitted with planning application number 162166/FUL), it was agreed that noise measurements and modelling using SoundPLAN would be the most appropriate method of determining the future noise levels at the site and potential impacts at local sensitive receptors.

1.9 For this study a noise assessment has been undertaken to determine both the constraints on, and impacts of the development. The constraints are how the existing environment, such as road traffic noise, will impact on the development. The impacts are how the presence of the development will impact on the existing environment. It is important to make the distinction between these two parts of the noise impact assessment as the approach to each will be different.

1.10 Constraints on development with regard to noise levels have been assessed using two methods. The first is through measured sound levels at the development site and the second is through calculation. The assessment years are 2016 (existing) and 2021 (5 years after submission of the Planning Application).

1.11 A noise level survey was undertaken adjacent to the A329 Vastern Road, at the Coopers BMW access and on top of the car park adjacent to the railway line on 26th September 2014. The results from the noise survey have been used to calibrate the noise model and determine the development area noise profile.

1.12 To calculate the existing and future noise profile of the site the computer modelling programme SoundPLAN which incorporates the calculation methods detailed in the Government publications Calculation of Road Traffic Noise (CRTN) 1988 and Calculation of Railway Noise (CRN) 1995 have been used.



- 1.13 The impacts of development generated traffic have been assessed using modelled road traffic data for the local highway network and SoundPLAN.
- 1.14 During construction the potential impact from activities within the site has been assessed using the “ABC” method described in BS 5228. At this stage, the timetable for construction and landscaping is not known. An approximation has been made as to what type of plant will be used for each phase. Although there are only a limited number of residential properties nearby, nonetheless the potential impacts have been assessed at distances of 5 metres to 70 metres from the noise source to the sensitive receptor.

The Nature, Measurement and Effect of Noise

- 1.15 Noise is often defined as sound that is undesired by the recipient. Whilst it is impossible to measure nuisance caused by noise directly, it is possible to measure the loudness of that noise. ‘Loudness’ is related to both sound pressure and frequency, both of which can be measured. The human ear is sensitive to a wide range of sound levels. The sound pressure level of the threshold of pain is over a million times that of the quietest audible sound. In order to reduce the relative magnitudes of the numbers involved, a logarithmic scale of decibels (dB) is normally used, based on a reference level of the lowest audible sound.
- 1.16 The response of the human ear is not constant over all frequencies. It is therefore usual to weight the measured frequencies to approximate the human response. The resulting ‘A’ weighted decibel, dB(A), has been shown to correlate closely to the subjective human response.
- 1.17 When related to changes in noise, a change of ten decibels from say 60 dB(A) to 70 dB(A) would represent a doubling in ‘loudness’. Similarly, a decrease in noise from 70 dB(A) to 60 dB(A) would represent a halving in ‘loudness’. A change of 3 dB(A) is generally considered to be just perceptible. **Table 1.1** details typical noise levels.



Table 1.1: Typical Noise Levels

Approximate Noise Level (dB(A))	Example
0	Limit of hearing
30	Rural area at night
40	Library
50	Quiet office
60	Normal conversation at 1 m
70	In a car
80	Household vacuum cleaner at 1 m
100	Pneumatic drill at 1 m
120	Threshold of pain



2.0 LEGISLATION AND POLICY

- 2.1 It is important to consider the relevant legislation, policy and associated guidance in relation to noise effects on a proposed development. Following the revocation of Planning Policy Guidance Note 24 'Planning and Noise' (PPG24), the National Planning Policy Framework (NPPF), British and International Standards and local authority guidance have become the relevant guidance with regard to noise and residential developments.

Calculation of Road Traffic Noise 1988 (CRTN)

- 2.2 It is common practice in the UK to assess the impacts of road traffic noise in accordance with the method prescribed in The Department for Transport document 'Calculation of Road Traffic Noise 1988 (CRTN)'. Paragraph 1 of the introduction states that:

"These procedures are necessary to enable the entitlement under the Noise Insulation Regulations to be determined but they also provide guidance appropriate to the calculation of traffic noise for more general applications e.g. environmental appraisal of road schemes, highway design and land use planning"

- 2.3 Section II of CRTN outline the procedures to be followed when calculating the prediction method for future road traffic noise and Section III of CRTN details the procedure and requirements to be met using the measurement method with details of a simplified measurement procedure.

- 2.4 All noise levels are expressed in the terms of the index $L_{10,(T)}$ dB(A) where L_{10} is the noise level exceeded for 10% of the time period (T) expressed in decibels with an A weighting, which broadly agree with the range of human hearing.

- 2.5 The shortened measurement method comprises measurement of L_{10} over any three consecutive hour periods between 10:00 and 17:00. Using L_{10} (3 hour) as the arithmetic mean of the three consecutive values of hourly L_{10} , the current value of L_{10} (18 hour) can be calculated using the formula:

$$L_{10} (18 \text{ hour}) = L_{10} (3 \text{ hour}) - 1 \text{ dB(A)}$$

- 2.6 Chart 7 in CRTN and the associated formulae can be used to adjust the recorded/calculated sound level from road traffic with a change in distance from the source.



Calculation of Railway Noise 1995 (CRN)

- 2.7 Within the UK the Department of Transport's publication Calculation of Railway Noise a method is prescribed which needs to be followed when assessing noise from railways.
- 2.8 The Technical Memorandum mainly deals with determining eligibility for insulation of residential properties from railway noise under the conditions specified in the Noise Insulation Regulations 1995.
- 2.9 However, CRN can be used to assess the likely impact of noise from railways, the design and location of new tracks or land use planning near existing or planned railways.
- 2.10 Section III of CRN details the procedures to be followed when measuring railway noise.

WHO Guidelines and BS 8233:2014

- 2.11 Guidance on absolute limits for noise inside buildings is provided in BS 8233:2014 "Sound insulation and noise reduction for buildings – Code of practice". Similar guidance can also be found in the current World Health Organisation (WHO) "Guidelines on Community Noise" and "Night Noise Guidelines for Europe" and the BRE/CIRIA document "Sound control for homes". A summary of the noise criteria can be seen in **Table 2.1**.

Table 2.1: Summary of Internal Noise Criteria: BS 8233 & WHO

Criterion	Activity	Location	0700 to 2300	2300 to 0700
BS 8233:2014	Resting	Living room	35 dB $L_{Aeq,16hr}$	-
	Dining	Dining room/area	40 dB $L_{Aeq,16hr}$	-
	Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$
WHO Onset of sleep disturbance		Bedroom		30 dB $L_{Aeq,8hr}$

- 2.12 Individual noise events such as passing trains have the potential to cause sleep disturbance and the WHO recommend a reasonable individual noise event of 45 dB ($L_{Amax,F}$) within the bedrooms during the night. Above this level the onset of sleep disturbance can occur.



- 2.13 Guidelines for external noise levels in public and private open space, such as gardens and parks, is available in the WHO guidelines. According to the WHO guidelines, during the daytime ($L_{eq,16hr}$), moderate annoyance may be experienced at noise levels between 50 dB(A) and 55 dB(A) and serious annoyance may be experienced above 55 dB(A).
- 2.14 During the night time ($L_{eq,8hr}$), an interim target (IT) level of 55 dB(A) is recommended (from WHO Night Noise Guidelines for Europe – 2009). The 55 dB(A) is the lowest observed adverse effect level (LOAEL).
- 2.15 However, it should be noted that the WHO Guidelines for Community Noise – 1999 recommend an external night time noise level of 45 dB(A) ($L_{eq,8hr}$) in relation to the reduction in noise level through an open window to achieve an internal noise level in bedrooms of 30 dB.
- 2.16 With regard to the prediction of noise levels from road traffic noise, the $L_{10,18hr}$ can be converted to $L_{Aeq,16hr}$ by subtracting 2 dB from the $L_{A10,18hr}$ (BS 8233 paragraph 6.2.2) $L_{Aeq,16hr} = L_{A10,18hr} - 2 \text{ dB}$.
- 2.17 The night time noise level, $L_{Aeq,8hr}$, can be calculated from $L_{A10,18hr}$ using the conversion formula in the TRL document “*Converting the UK traffic noise index $L_{A10,18hr}$ to EU noise indices for noise mapping*”.

Design Manual for Roads and Bridges (DMRB)

Magnitude of Impacts

- 2.18 Whilst, DMRB is principally used for the assessment of the environmental impacts of roads it provides a useful method for considering the noise impacts of traffic generation onto the existing highway network from new development. DMRB includes a semantic scale for the classification of the magnitude of noise impacts following the completion of a proposed development. This is a useful tool for assessing noise impacts. The scale is shown in **Table 2.2**.

Table 2.2: Classification of Magnitude of Noise Impacts in the Short Term

Noise change, $L_{A10,18hour}$	Magnitude of Impact
0	No change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major



- 2.19 The changes in noise level and the magnitude of impact presented in Table 2.2 are used to assess the daytime period. At the time of writing this report, DMRB recommends using the 'classification of magnitude of noise impacts in the long term' for the assessment of night time noise levels. The 'long term' scale is shown in **Table 2.3**.

Table 2.3: Classification of Magnitude of Noise Impacts in the Long Term

Noise change, $L_{A10,18\text{hour}}$	Magnitude of Impact
0	No change
0.1 – 2.9	Negligible
3 – 4.9	Minor
5 – 9.9	Moderate
10+	Major

- 2.20 Also recommended in DMRB is the assessment of night time noise levels at sensitive receptors with an $L_{\text{night,outside}}$ exceeding 55 dB (until further research is available). The $L_{\text{night,outside}}$ 55 dB corresponds to the Interim Target level specified in the WHO Night Noise Guidelines for Europe.

Significance of Effects

- 2.21 Once the magnitude of impact is determined, the next step is to assess the significance of the effect. Reproduced in **Table 2.4** is commonly used method for the definition of the sensitivity of receptors.



Table 2.4: Criteria used to define noise sensitive receptors (from Watts, 1984*)

Sensitivity	Description	Examples of receptor use
High	Receptors where people or operations are particularly susceptible to noise	- Residential, - Quiet outdoor areas used for recreation, - Conference facilities, - Auditoria/studios, - Schools in the daytime, - Hospitals/residential care homes, - Religious institutions, e.g. churches, mosques.
Medium	Receptors moderately sensitive to noise, where it may cause some distraction or disturbance	- Offices, - Restaurants, - Sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary, e.g. tennis, golf.
Low	Receptors where distraction or disturbance from noise is minimal	- Residences and other buildings not occupied during working hours, - Factories and working environments with existing high noise levels, - Sports grounds when spectator noise is a normal part of the event.

2.22 Based on the advice provided in HA 205/08 (DMRB) a matrix of 'overall level of significance' has been produced using the magnitude of change (Table 2.2 and Table 2.3), the sensitivity of the receptor (Table 2.4) and the significance of the effect and is presented in **Table 2.5**.

Table 2.5: Significance of noise effects

Magnitude of Impact	Sensitivity of receptor/resource		
	<i>Low</i>	<i>Medium</i>	<i>High</i>
Major	Slight/moderate	Moderate/large	Large/very large
Moderate	Slight	Moderate	Moderate/large
Minor	Neutral/slight	Slight	Slight
Negligible	Neutral/slight	Neutral/slight	Slight
No Change	Neutral	Neutral	Neutral

2.23 The cells within Table 2.5 shaded grey are considered to be significant effects and mitigation may be required. The remainder of the cells in Table 2.5 are an indication of the significance of effects below the significance threshold.

* Watts, G R, (1984) *Vibration nuisance from road traffic – results of a 50 site survey*, TRL Research Report 1119, Transport Research Laboratory, Department of Transport, Crowthorne.



BS 5228-1:2009

- 2.24 Within BS 5228 “Code of practice for noise and vibration control on construction and open sites – Part 1: Noise” a method for predicting noise from construction activity is provided. It is the accepted Standard employed for the assessment of noise and vibration from construction sites.
- 2.25 The Standard also provides a framework for good working practice and guidance on methods of mitigating noise by employing a number of different techniques.
- 2.26 Annex E of BS 5228 outline three approaches to the assessment of significance of noise effects which are:
- i) Significance based on fixed noise limits. Noise levels should not exceed 70 dB(A) in rural, suburban and urban areas away from main road traffic and industrial noise, or 75 dB(A) in urban areas near main roads in heavy industrial areas;
 - ii) Significance based on noise change – method 1. Noise levels should not exceed thresholds determined from existing ambient noise levels using the “ABC Method”:
 - A - 65 dB (daytime) when ambient noise levels (when rounded to the nearest 5 dB) are less than this value,
 - B - 70 dB (daytime) when ambient noise levels (when rounded to the nearest 5 dB) are the same as the category A value,
 - C - 75 dB (daytime) when ambient noise levels (when rounded to the nearest 5 dB) are higher than the category A value.
 - iii) Significance based on noise change – method 2. Construction noise levels are deemed to be significant if the total noise (ambient + construction) exceeds the pre-construction ambient noise level by 5 dB or more, subject to the lower cut-off value of 65 dB (daytime).

National Planning Policy Framework (NPPF)

- 2.27 The NPPF set out the Government’s latest planning policies for England. There are a number of sections within the NPPF which mention noise in a planning context and they have been reproduced below.



2.28 The first time noise is mentioned is at Section 11. “Conserving and enhancing the natural environment” which states, amongst other things, that:

“The planning system should contribute to and enhance the natural and local environment by:

- *Preventing both new and existing development from contributing to or being put at an unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability;...”* (Paragraph 109).

“Planning policies and decisions should aim to:

- *Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of a new development;*
- *Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
- *Recognise that development will often create some noise and existing business wanting to develop in continuance of their business should have not unreasonable restrictions put on them because of changes in nearby land uses since they were established, and*
- *Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason...”*(Paragraph 123).

Noise Policy Statement for England (NPSE)

2.29 The National Policy Statement for England (NPSE) aims to ‘through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life;*
and
- *where possible, contribute to the improvement of health and quality of life’. (Paragraph 1.8).*



National Planning Practice Guidance (NPPG)

- 2.30 The National Planning Practice Guidance (NPPG), published March 2014, provides advice on how to determine the noise impact on development:

“Local planning authorities’ plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- *whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved.*

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation. As noise is a complex technical issue, it may be appropriate to seek experienced specialist assistance when applying this policy.” (Paragraph 004).

- 2.31 The document goes on to provide a definition for the levels of noise exposure at which an effect may occur:

“Significant observed adverse effect level: *this is the level of noise exposure above which significant adverse effects on health and quality of life occur.*

Lowest observed adverse effect level: *this is the level of noise exposure above which adverse effects on health and quality of life can be detected.*

No observed effect level: *this is the level of noise exposure below which no effect at all on health and quality of life can be detected.” (Paragraph 005).*

- 2.32 It is important to understand that as the NPPG does not provide any advice with respect to specific noise levels/ limits for different sources of noise, it is appropriate to consider other sources of advice and guidance documents when considering whether new developments would be sensitive to the prevailing acoustic environment.



ProPG: Planning & Noise

- 2.33 The Professional Practice Guidance on Planning and Noise (ProPG) has been produced by the Institute of Acoustics (IOA), the Association of Noise Consultants (ANC), and the Chartered Institute of Environmental Health (CIEH) to provide practitioners with guidance on the management of noise within the planning system in England.
- 2.34 Amongst other things, ProPG aims to:
- *“Advocate full consideration of the acoustic environment from the earliest possible stage of the development control process;*
 - *encourages the process of **good acoustic design** in and around new residential developments;*
 - *outline what should be taken into account in deciding planning applications for new noise-sensitive developments;*
 - *promote appropriate noise exposure standards;*
 - *And assist the delivery of sustainable development.” (Paragraph 1.6)*
- 2.35 The Guidance provides recommended approaches for new residential developments and offers recommendations to the decision maker. For example, ProPG recommends that maximum internal noise levels should not normally exceed 45 dB $L_{A_{MAX,F}}$ more than 10 times per night.

Local Council Policy

- 2.36 Current local policy for Reading Borough Council (RBC) is the RBC Local Development Framework (LDF) which includes the Core Strategy, Reading Central Area Action Plan, and, Sites and Detailed Policies Documents (SDPD) which are under review in 2016 with the aim of drawing up a New Local Plan for the Borough, setting out how Reading will develop up to 2036.
- 2.37 RBC do not have a specific Supplementary Planning Document (SPD) on noise, however they do provide general guidance on the RBC website with regard to “Noise and the Planning Process”. There are a number of headings on the web page which relate to “Noise impact on residential development”, “Noise arising from commercial / industrial development” and “Plant noise criteria”. The criteria detailed in British Standard (BS) 8233, World Health Organisation



(WHO) and BS 4142 are all referenced on the web page. Relevant details from the aforementioned guidelines standards are referred to later on in this report.

- 2.38 Within the Core Strategy, Policy CS34: Pollution and Water Quality deals specifically with pollution and water quality with regard to development and states:

“Development will only be permitted where it would not be damaging to the environment through air, land, noise or light pollution; where it would preserve or ideally enhance ground and surface water quality; and where existing water resources, sewerage and wastewater treatment infrastructure are adequate to support the proposed development.

Proposals for development that are sensitive to the effects of air, noise or light pollution will only be permitted in areas where they will not be subject to high levels of such pollution, unless adequate mitigation measures are provided to minimise the impact of such pollution.

Development will be permitted on land affected by contamination where it can be demonstrated, to the satisfaction of the LPA, that the contamination can be satisfactorily remediated so that it is suitable for the proposed end use.”

- 2.39 The Reading Central Area Action Plan is one of RBC Development Plan Documents (DPD) and should be read in conjunction with other LDF documents. Policy RC9: Living in the Centre presents criteria which proposed development in the centre of Reading should be assessed against. The policy covers a number of criteria and with regard to air quality states that:

“Proposals for residential development within the central area will be assessed against the following criteria:

ii. Proposals for new residential development within the central area will be required to demonstrate how the issue of potential noise disturbance from neighbouring land uses and other sources, and air quality implications of residential development, have been considered and if necessary, mitigated. New residential development should not be located next to existing town centre uses where those uses would give rise to unacceptable levels of noise and disturbance to the occupiers of the new scheme, unless this can be mitigated.”



2.40 Within the SDPD there are a number of policies which mention noise however the most relevant policy with regard to new residential development is Policy DM4: Safeguarding Amenity which states that:

“Development will not cause a significant detrimental impact to the living environment of existing or new residential properties, in terms of:

- *Privacy and overlooking;*
- *Access to sunlight and daylight;*
- *Visual dominance and overbearing effects of a development;*
- *Noise and disturbance;*
- *Artificial lighting;*
- *Vibration;*
- *Dust and fumes;*
- *Smell; or*
- *Crime and safety.*

The position of habitable rooms, windows and outdoor living spaces will be particularly important.....

As well as immediate impacts, other aspects to which this policy applies will include matters such as hours of operation of businesses, and effects of traffic movements, particularly of heavy goods vehicles (HGVs). Proposals which would generate regular movements of HGVs on residential roads will not be acceptable.

Where an otherwise acceptable development could change its character to a use that would have a greater impact on amenity without needing planning permission, conditions will be applied to restrict such changes.”



3.0 METHODOLOGY

- 3.1 This section describes the approach to assessing the noise constraints and impacts in respect of the proposed development of the former Coopers BMW site, Reading. It is important to note that the assessment deals with both constraints (effects of the surrounding environment on the proposed development) and impacts (effects of the development on the surrounding environment), as well as any impacts during the construction phase of the development.
- 3.2 From on-site observations, road traffic noise from the A329 Vastern Road and the broader highway network and the railway line are the dominant noise sources in the local area. The road to the west of the site is the A329 Vastern Road with King's Meadow Road to the north. The broader highway network includes Napier Road to the east, the B3345 George Street (Reading Bridge) and Forbury Road and the A329 Forbury Road to the south of the railway line. To the south of the site is the main east/west railway line from London to the south west. Therefore SoundPLAN which incorporates the methods detailed in CRTN and CRN have been used to calculate the existing and future noise levels at the development site.
- 3.3 The basic outline methodology employed is detailed below:
- Utilise recorded sound levels and traffic flow data and SoundPLAN to establish the existing noise profile of the site 2016;
 - Utilise traffic flow data to establish the "Existing" noise levels at sensitive receptors;
 - Determine the impacts from construction activities on local receptors using BS 5228:
 - Utilise traffic flow data to establish the "Future" scenario for 2021;
 - Utilise traffic flow data to establish the "Future + Proposed Development" scenario for 2021;
 - Determine the constraints from the "Do Something" scenario for sensitive receptors on the development;
 - Determine the changes in noise levels from the "Do Nothing" and "Do Something" scenarios for sensitive receptors in the existing surrounding area;



- Compare the constraints and impacts against relevant noise standards or objectives.



4.0 EXISTING NOISE PROFILE

- 4.1 The existing noise profile of the development site was determined through measurement and calculation of noise levels. The shortened measurement method as detailed in Section III of CRTN and the method detailed in section III of CRN have been used to record and calculate the existing noise level at the measurement position. The results from the noise surveys have been entered into SoundPLAN which has been used to determine the daytime and night time noise profile of the development site.

Noise Level Survey

- 4.2 The environmental noise measurement method detailed in British Standard 7445:1991 was used to record the 'A' weighted ambient ($L_{eq,T}$), maximum ($L_{max,T}$), background ($L_{90,T}$) and 10th percentile ($L_{10,T}$) noise levels. For this noise assessment the reference time period, T, were sixteen hours during the daytime and eight hours during the night time.
- 4.3 Noise levels were recorded at three different locations. The first location was adjacent to the A329 Vastern Road, the second location was on the top floor of the Coopers BMW car park and adjacent to the railway line and the third location was at the site access adjacent to Napier Road. Three consecutive hours of sound were recorded at locations one and three and over 20 hours of sound levels were recorded at location two.
- 4.4 At the first location the sound level meter (SLM) was positioned within the site boundary and adjacent to the A329 Vastern Road roundabout. At the second location the SLM was positioned in the south west corner of the three storey car park overlooking the railway lines. The third location was on the western footway at the Cooper BMW site access road. The location of the measurement positions SLM1, SLM2 and SLM3 are presented on Figure 1.1.
- 4.5 The SLM microphone was mounted at grazing incidence 1.5 metres above ground level on a tripod at all the monitoring locations. The SLM was calibrated before and after the measurement periods using an acoustic calibrator. The acoustic calibrator was set to 94 dB at a frequency of 1000 Hertz.
- 4.6 The local weather conditions were recorded at the start of the measurements and at regular interval throughout the measurement period. A description of the weather conditions are presented later on in this chapter.



Equipment Used

- 4.7 The equipment used during the field measurements on site are listed in **Table 4.1**. The SLM and acoustic calibrator have been calibrated at an UKAS accredited centre (certificates available on request).

Table 4.1: Equipment used during the field measurements

Equipment	Type	Serial Number
Sound Level Meter	Brüel and Kjær Type 2250 Light	3004648
Microphone	Brüel and Kjær Type 4950	2913913
Calibrator	Brüel and Kjær Type 4321	2388830
Anemometer/thermometer	Kestrel 2000	449331
Tripod	Mirander – 1.5 metre	

Results from the Noise Monitoring

Noise Levels

- 4.8 On Thursday the 25th September 2014 the first set of three hour measurements started at 0931 and ended at 1231. The second set of three hour measurements were recoded between 1000 and 1300 on Friday the 26th September 2014. Presented in **Table 4.2** is a summary of the results from the measurements.

Table 4.2: Summary of Recorded Noise Levels at SLM1 and SLM3 (3 hour)

Measurement Location	Time	Ambient Noise Level ($L_{Aeq,3hr}$)	Maximum Noise Level ($L_{Amax,T}$)	10 th Percentile Noise Level ($L_{A10,3hr}$)	Background Noise Level ($L_{A90, 3hr}$)
SLM1	0931-1231	69.1	102.6	63.5	69.6
SLM3	1000-1300	69.6	86.3	58.1	73.6

- 4.9 At SLM1, the measured ambient noise level was 69.1 dB(A) $L_{eq,3hr}$, the measured background noise level was 63.5 dB(A) $L_{90,3hr}$ and the three hour 10th percentile noise level was measured as 69.6 dB(A) $L_{10,3hr}$.
- 4.10 At SLM3, the measured ambient noise level was 69.6 dB(A) $L_{eq,3hr}$, the measured background noise level was 58.1 dB(A) $L_{90,3hr}$ and the three hour 10th percentile noise level was measured as 73.6 dB(A) $L_{10,3hr}$.



4.11 Between the two sets of three hour measurements the SLM was positioned on top of the three storey car park and recorded sound levels for just over 20 hours. At this location railway noise is dominant. The measurements started at 1319 on the 25th September and ended at 0927 on the 26th September and the results are presented in **Table 4.3**.

Table 4.3: Summary of Recorded Noise Levels at SLM2 (1 hour)

Measurement Location	Time	Ambient Noise Level (L _{Aeq,3hr})	Maximum Noise Level (L _{Amax,T})	10 th Percentile Noise Level (L _{A10,3hr})	Background Noise Level (L _{A90, 3hr})
SLM2	1319-1419	67.5	87.9	69.9	54.7
SLM2	1419-1519	67.5	90.8	67.9	55.0
SLM2	1519-1619	67.8	86.8	69.2	57.4
SLM2	1619-1719	72.3	94.6	70.2	52.9
SLM2	1719-1819	67.1	90.9	69.2	50.1
SLM2	1819-1919	66.4	87.6	69.1	50.9
SLM2	1919-2019	68.3	88.5	68.3	48.6
SLM2	2019-2119	66.8	88.8	68.7	47.6
SLM2	2119-2219	65.3	88.7	61.0	46.3
SLM2	2219-2319	64.5	87.1	60.6	45.0
SLM2	2319-0019	64.7	90.5	62.0	42.8
SLM2	0019-0119	62.7	86.6	53.9	39.8
SLM2	0119-0219	61.7	80.5	54.2	37.7
SLM2	0219-0319	58.4	85.3	46.6	36.7
SLM2	0319-0419	60.7	86.4	46.6	35.4
SLM2	0419-0519	67.0	90.9	60.6	39.5
SLM2	0519-0619	65.2	87.0	58.4	43.1
SLM2	0619-0719	68.6	89.2	70.4	47.1
SLM2	0719-0819	69.8	92.5	70.2	55.2
SLM2	0819-0919	70.4	91.5	68.6	56.3



- 4.12 Sound levels for each train pass-by were recorded as L_{AE} (SEL). The measurement was taken whilst the train was audible and passing the measurement position. From the measured L_{AE} (SEL), the mean average L_{AE} (SEL) for each train type can be determined, refer to Table 4.4.

Table 4.4: Summary of Recorded Train Noise Levels, Number of Trains and Daytime and Night Time Noise Levels at SLM2

Average L_{AE} (SEL) for each train type, distance and day or night				
			L_{AE} to L_{Aeq}	
Operator and distance	L_{AE} (SEL) dB	Number of Trains	Day (0600 – 2400)	Night (0000 – 0600)
GWR at 17m	77.3	259	53.3	
		17		46.3
GWR at 22m	74.2	239	49.9	
		11		41.3
GWR at 32m	68.3	65	38.4	
		2		27.2
GWR at 35m	66.0	91	37.5	
		5		30.0
SWT at 42m	61.6	79	32.5	
		6		26.1
Freight Trains	70.4	21	35.6	
		2		30.1
KEY: Great Western Railway (GWR), South West Trains (SWT), distance in metres (m) from sound level meter to centre of railhead				

- 4.13 Using the method described in paragraph 32 of CRN, the L_{AE} can be converted to $L_{Aeq,T}$ for the daytime and night time periods.
- 4.14 It should be noted that The Great Western Main Line is undergoing electrification, and therefore a significant proportion of the trains will be quieter than has been measured. This report is assessing a worst-case scenario.



Weather Conditions

- 4.15 The weather conditions varied over the three noise measurement surveys. During the first survey (0930 – 1230), the air temperature was 16°C, and the wind speed was 1 ms⁻¹ (average). At the beginning of the second survey (1320), the air temperature was 18.7°C, and the average wind speed was 1.4 ms⁻¹. At the end of the second survey (0930 *following day*), the air temperature was 19.4°C and the wind speed was 0.4 ms⁻¹. For the third survey (1000 – 1300), the air temperature was 21°C and the wind speed was 0.4 ms⁻¹ (average). Throughout the surveys, the wind was from the south, there was light cloud but no fog and the ground was dry.

Existing Noise Levels

- 4.16 As detailed above, the existing noise levels at the development site have been measured adjacent to the A329 Vastern Road roundabout, on top of the car park and at the site entrance. However, existing façade noise levels at sensitive receptors outside of the development site have been calculated using SoundPLAN. Road traffic data for the opening year of Reading Train Station improvements on the local highway network has been provided partially by Peter Brett Associates via Reading Borough Council. The remaining traffic data was collected using permanent ATC on A329 Forbury Road, A329 Caversham Road and the A4155 Caversham Road and has been obtained from the Department for Transport (DfT) website for 2013. Where traffic data was not available for the 18 hour period used in the traffic noise modelling, locally derived factors have been utilised to convert peak hour traffic to 18 hour flows.

Road Traffic Data

- 4.17 The roads within the assessment area and used for the façade noise level calculations are King's Meadow Road/Napier Road, the A329 Vastern Road, B3345 George Street, the A329 Forbury Road, Forbury Road, the A329 Caversham Road and the A4155 Caversham Road. Presented in **Table 4.5** are the road traffic flows for 2016.



Table 4.5: Road traffic flows for the base year 2016

Road Name	2016 "Existing"	
	<i>Total 18hr Traffic</i>	<i>%HGV</i>
King's Meadow Road/Napier Road	7859	2.0
B3345 George Street (Reading Bridge)	35884	2.5
A329 Vastern Road (E of Reading Bridge Roundabout)	42674	4.4
A329 Vastern Road (under the railway line)	42319	4.8
A329 Forbury Road	36914	3.6
Forbury Road	10207	9.3
A329 Vastern Road (Caversham Rd Roundabout)	48575	5.0
A329 Caversham Road	35743	4.7
A4255 Caversham Road	28657	4.2

Sensitive Receptors - 2016

- 4.18 Receptors sensitive to changes in noise levels (residential) have been identified adjacent to Napier Road (22 The Lodge), the A329 Vastern Road (41 Vastern Road) and Forbury Road (Rising Sun). There are also a number of offices to the north and east of the proposed development site and these will also experience any changes in noise level due to development generated traffic. To the north of the site are North Reading Bridge House and King's Meadow House and to the east of the site is Napier Court.
- 4.19 The receptor locations are provided on **Figure 4.1** and a full set of results are presented in **Appendix 1**. Presented in **Table 4.6** are the results from the noise modelling of the "Existing" situation adjacent to the aforementioned roads.



Table 4.6: Existing noise levels at sensitive receptors – 2016

Receptor Number and Location		Façade Direction	Floor Level	'Existing' situation	
				Daytime L _{eq,16hr} dB(A)	Night Time L _{eq 8hr} dB(A)
1	22 The Lodge	SW	GF	62.1	52.1
		SW	FF	64.2	54.1
2	41 Vastern Road	SW	GF	72.6	61.9
		SW	FF	73.7	63.0
		SW	SF	73.6	62.9
3	Rising Sun PH	NE	GF	70.6	60.1
		NE	FF	71.9	61.3
4	North Reading Bridge House	E	GF	54.6	45.2
		E	FthF	59.1	49.3
		E	TpF	59.4	49.7
		S	GF	69.5	59.0
		S	FthF	71.9	61.3
		S	TpF	70.4	60.0
		W	GF	68.4	58.0
		W	FthF	72.1	61.5
		W	TpF	71.1	60.6
5	King's Meadow House	S	GF	58.5	48.8
		S	TF	61.5	51.6
		S	SxF	63.1	53.1
6	Napier Court	W	GF	60.6	51.1
		W	FF	62.7	53.1
		N	GF	68.0	57.6
		N	FF	67.8	57.4
KEY: N – north, E – east, S – south, W – west, GF – ground floor, FF – first floor, SF – second floor, TF – third floor, FthF – fifth floor, SxF – sixth floor and TpF – top floor,					

- 4.20 At all the receptors road traffic noise and railway noise are the main contributors to façade noise levels. Façade noise levels are between 54.6 dB and 73.7 dB during the daytime and between 45.2 dB and 63.0 dB during the night time.
- 4.21 The highest daytime and night time noise levels are adjacent to the A329 Vastern Road (R2) and the lowest are on the eastern façade of North Reading Bridge House offices (R4).



Development Site

- 4.22 Existing noise levels within the development site have been modelled using the SoundPLAN computer noise model which incorporates the calculation methods detailed in CRTN and CRN. Daytime and night time noise profiles have been calculated using the above method, traffic data for the surrounding roads and measured sound levels from railway traffic.
- 4.23 The CRTN shortened measurement method was used to record noise levels within the development site and using the method detailed in paragraph 2.5 and paragraph 2.16 results in a **daytime** noise level of 66.6 dB(A) $L_{eq,16hr}$ at SLM1 ($69.6 \text{ dB } (L_{10,3hr}) - 1 \text{ dB} = 68.6 \text{ dB } (L_{10,18hr}) - 2 \text{ dB} = 66.6 \text{ dB } (L_{eq,16hr})$) and 70.6 dB(A) at SLM3 ($73.6 \text{ dB } (L_{10,3hr}) - 1 \text{ dB} = 72.6 \text{ dB } (L_{10,18hr}) - 2 \text{ dB} = 70.6 \text{ dB } (L_{eq,16hr})$).
- 4.24 The **night time** noise level within the site has been calculated using the method detailed in paragraph 2.17 which results in a noise level of 58.9 dB $L_{eq,8hr}$ at SLM1 and 62.5 dB(A) at SLM3. The measurements results have been used to verify the results of the noise model.
- 4.25 Noise contours have been calculated at 1.5 metres above ground level and the results from the noise model are presented on **Figure 4.2** (daytime 0700 – 2300) and **Figure 4.3** (night time 2300 – 0700).

Impact Assessment Methodology

Constraints

- 4.26 The constraints are assessed for the “Do Something” (Future + Committed Development + Proposed Development) scenario. The traffic noise levels at the development are predicted using the methodology identified in the Technical Memorandums “Calculation of Road Traffic Noise - 1988” (CRTN).
- 4.27 Using the results of the modelling, the future noise levels across the site are assessed against the WHO guidelines for external noise levels, the British Standard 8233 for internal noise levels and against any local noise policy.
- 4.28 Depending on the external noise levels, there may be a requirement for mitigation. If mitigation is required then the WHO Guidelines and BS 8233 will be used to establish suitable internal noise levels.



Impacts – Construction

- 4.29 The potential impacts from demolition (if required), site clearance, construction and landscaping have been determined using the ABC method as detailed in BS 5228 part 1.

Impacts - Operation

- 4.30 The noise impact of the proposed development on the surrounding area has been assessed by considering the changes in traffic flows which will occur on the existing highway network with the development in place.
- 4.31 The predicted traffic flows and SoundPLAN are used to predict the noise levels at the sensitive receptors within the assessment area. The noise levels are then compared to the assessment criteria, which utilises the semantic scale from DMRB in order to determine the magnitude of any noise impacts.



5.0 NOISE ASSESSMENT

- 5.1 From Figures 4.2 and 4.3 it can be seen that land adjacent to Vastern Road and King's Meadow Road experiences noise levels above 63 dB during the daytime (0700 – 2300) and 55 dB during the night time (2300 – 0700).
- 5.2 As there are areas with noise levels above 55 dB(A) during the daytime and above 45 dB(A) during the night time a commensurate level of mitigation will be required to achieve internal and noise levels that comply with British Standards and WHO guidelines.
- 5.3 Noise can enter a building, whether commercial or residential, through windows, ventilators, walls, roof and doors. In most cases, however, windows provide the main path for noise and it is important they be insulated properly. Section 8.4.7 of BS 8233 (2014) "Windows" Table 10, details the noise reduction of a thermal insulating window (6 – 12 – 6) as of the order of 33 dB(A) for a closed window and 10 dB(A) to 15 dB(A) for a partially open window.
- 5.4 As detailed in Table 2.1 of this report, BS 8233 suggests that internal **daytime** ($L_{eq,16hr}$) noise levels of 40 dB(A) and 35 dB(A) are design targets for dining rooms, and living rooms and bedrooms respectively. During the **night time**, ($L_{eq,8hr}$) internal noise levels in bedrooms should be 30 dB(A) and noise due to individual events ($L_{max,t}$) should not exceed the 45 dB(A) threshold. To achieve an internal noise level of 30 dB(A) with an open window, façade noise levels must be no greater than 45 dB(A) ($45 - 15 = 30$ dB(A)).
- 5.5 Section 5.4.4 of BS 8233 (2014) "Obstructing the sound" gives examples of how sound can be enclosed or obstructed by a solid barrier such as a fence between the noise source and receiver. It should be noted that attenuation levels of around 10 dB are common; however, the benefits from ground absorption may be reduced.
- 5.6 Outside amenity space in the southern part of the development will be shielded from road traffic noise by the proposed residential buildings. It should also be noted that the proposed amenity space on floor level 11 will also be shielded from road traffic noise by the proposed residential buildings. The construction of the buildings will help shield the amenity area from road traffic noise and a reduction of up to 10 dB is possible.



- 5.7 The Buildings Research Establishment (BRE) and Construction Industry Research and Information Association (CIRIA) publication 'Sound Control for Homes' 1993 presents practical advice on the control within dwellings of noise from outside sources and noise transmitted within and between dwellings. Part B: Scheme Design – Planning to control external noise, gives advice on the potential noise reduction from low-rise dwellings acting as a barrier block between the noise source and noise sensitive areas.
- 5.8 The first paragraph on page 24 of BRE and CIRIA publication Sound Control for Homes states that 'On an estate of low rise dwellings, those closest to a noise source can give some protection to the remainder of the site'. The order of reduction in noise levels behind these buildings can be in the order of 10 dB for the whole site, where the gaps between the dwellings not exceeding 30% of the site frontage.
- 5.9 Table 13 of the BRE and CIRIA publication Sound Control for Homes gives guidance on the 'design background noise levels arising from external sources' and suggests that an internal noise level of <50 dB for less sensitive areas such as the kitchen, bathroom utility room, WC and internal and communal circulation areas is acceptable.
- 5.10 The World Health Organisation (WHO): Guidelines for Community Noise report covers, amongst other things, recommended internal and external noise levels for residential dwellings. From "Table 6.1: Guideline values for community noise in specific environments", it can be seen that for outdoor living areas a guideline for serious and moderate annoyance for both daytime and evenings is 55 dB(A) and 50 dB(A) respectively.



6.0 EFFECTS OF THE PROPOSALS DURING CONSTRUCTION

Effect of Construction Noise on Nearby Sensitive Receptors

- 6.1 The magnitude of construction noise impacts can be predicted by considering noise emissions data for typical construction equipment based on the expected methods of construction for each phase of work on each worksite. The prediction method follows that recommended in BS 5228 Noise and Vibration Control on Construction and Open Sites, Part 1:2009.
- 6.2 The guidance contained in BS 5228 does not extend to provide criteria against which to assess construction noise. However, the Department of Environment (DoE) Advisory Leaflet (AL) 72 (1976) "Noise Control on Building Sites" gives advice on the maximum levels of construction site noise at residential locations during daytime hours based on levels associated with speech interference. This publication states that during daytime hours (0700 to 1900 hours) the L_{Aeq} noise level at the building façade should not exceed:
- 75 dB in urban areas, near main roads or in heavy industrial areas:
and
 - 70 dB in rural, suburban and urban areas away from main road traffic and industrial noise.
- 6.3 At the time of writing the report, the demolition and site clearance activities are underway. The former BMW showroom has been demolished and the site has been cleared. The car park is still to be demolished. At present, the exact program of works is not known, however, site preparation/demolition of the car park and construction will take place in accordance with the following summary:
- Demolition/site preparation;
 - Groundwork;
 - Construction and highway works; and
 - Landscaping.
- 6.4 Site preparation and demolition activities will be across the site along with the groundwork and landscaping. Other activities will be more localised and of varying duration.



- 6.5 An assessment has been undertaken using generic construction machinery and operation at distances from 20 metres to 80 metres from the noise source. The construction noise assessment is presented in **Appendix 2** and the results are summarised below.
- 6.6 There are four “Sensitive Receptors” adjacent to the site and these are: Napier Court (east of site); Reading Bridge House (north west of site); 22 The Lodge (north east of site) and King’s Meadow House (north of site).
- 6.7 Napier Court and Reading Bridge House are approximately 30 metres from the site, “22 The Lodge” is approximately 40 metres from the site and King’s Meadow House is approximately 50 metres.
- 6.8 The daytime ($L_{Aeq,16hr}$) façade noise levels at the four receptors are: Napier Court – 60 dB(A); 22 The Lodge – 62 dB(A); King’s Meadow House – 58 dB(A); and Reading Bridge House – 69 dB(A).
- 6.9 According to the BS 5228 ‘ABC Method’, the corresponding threshold of significance for the noise levels is 65 dB (Napier Court and King’s Meadow House), 70 dB (22 The Lodge) and 75 dB at Reading Bridge House.
- 6.10 The results from the “Construction” noise calculations and the BS 5228 threshold of significance for each receptor are summarised in **Table 6.1**.

Table 6.1: Construction noise levels at sensitive receptors

Receptor Location (distance from site in metres)	Predicted Noise level, dB(A)				BS 5228 Threshold of Significance dB(A)
	<i>Demolition</i>	<i>Earthworks</i>	<i>Construction</i>	<i>Landscaping</i>	
Napier Court (at 30m)	73	77	77	68	65
22 The Lodge (at 40m)	71	75	75	67	70
King's Meadow House (at 50m)	69	73	73	65	65
Reading Bridge House (at 30m)	74	77	78	72	75



- 6.11 Noise from some construction activities will be audible at the nearest sensitive receptor locations and the calculations indicate that construction noise impacts may be significant. However, if Best Practical Means (BPM) is implemented then noise impacts can be minimised. A list of common mitigation strategies and how BPM can be implemented is given in Section 6. It should be noted that construction impacts are temporary and people are generally more tolerant of higher noise levels if they know they are only going to be of a temporary duration.



7.0 EFFECTS OF THE PROPOSALS POST-CONSTRUCTION

Introduction

- 7.1 In order to consider the effects of the proposals during the operational phase it is necessary to split the assessment into constraints and impacts. As mentioned in paragraph 1.6 constraints deal with the effect of the existing environment on the development and impacts deal with the effect of the development on the existing environment.
- 7.2 The internal noise levels of the proposed residential development have been assessed by using calculated façade noise levels with the mitigation from both a closed window and also an open window in the façade and the results have been assessed against British Standards and WHO guidelines.
- 7.3 External noise levels in the amenity areas have been calculated including the mitigation provided by the proposed residential buildings. The resultant external noise levels have also been assessed against British Standards and WHO guidelines.

Constraints

- 7.4 From Figure 4.2 and Figure 4.3 it can be seen that adjacent to Vastern Road and King's Meadow Road noise levels are above 63 dB during the daytime and above 55 dB during the night time and decrease slightly within the site. The aforementioned noise levels have been calculated at 1.5 metres above ground level, however the lowest proposed residential apartments are approximately 5 metres above ground level up to the penthouse apartments which are approximately 72 metres above ground level.
- 7.5 The constraints of the proposal post-construction on sensitive receptors within the development are examined for the "Do Something" (Future + Committed Development + Proposed Development) scenario. The constraints are assessed at all floor levels including the penthouse apartment level and on all façades.



- 7.6 The SoundPLAN model, incorporating future traffic flow data, has been used to predict the daytime and night time noise levels in 2021 for the “Do Something” (Future + Committed Development + Proposed Development) scenario. From the results, noise levels across the site are determined and assessed against current guidelines and British Standards. The noise levels within SoundPLAN are adjusted from an $L_{A10,18hr}$ to $L_{Aeq,16hr}$ and $L_{Aeq,8hr}$ using the conversion formula in the TRL document “*Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping*”.
- 7.7 A “Proposed Site Plan” has been used to establish the approximate location of the proposed building and two terraces.
- 7.8 The daytime and night time noise profiles of the development area for the “Do Something” scenario (Future + Committed Development + Proposed Development) are provided on **Figure 7.1** and **Figure 7.2** respectively. As with Figure 4.2 and Figure 4.3 the contour plots are displayed as 3 dB coloured bands with a key in the top right hand corner.

Residential development façade Noise Levels - 2021

- 7.9 For this assessment, façade noise levels have been calculated using the modelling software SoundPLAN which utilises the methods detailed in CRTN.
- 7.10 The development has been split into four elements: Central Element; Eastern Element; West Tower; and Parking Levels. The approximate locations of the proposed building and the façade receptors are presented in **Figure 7.3**.
- 7.11 All façades have been modelled within SoundPLAN and the results from the modelling are presented in **Appendix 3**. Façade noise levels at all floors within the development have been modelled.
- 7.12 Presented in **Table 7.1** are the predicted façade noise levels of the proposed apartments at the Main Base Building (Parking Levels) of the development. The apartments are at first and second floor levels (F 1 and F 2 respectively). There are no apartments proposed at ground floor level.



Table 7.1: Predicted façade noise levels at the “Main Base Building” of the development – 2021

Receptor Number (App. 3 Ref. No.) and Location		Façade Direction	Floor Level	‘Future’ situation	
				Daytime L _{eq,16hr} dB(A)	Night Time L _{eq,8hr} dB(A)
1	Adjacent to railway	S	F 1	53.8	46.2
2	Perpendicular to railway	E	F 1	55.9	47.4
3	Adjacent to car park entrance	E	F 1	57.8	48.9
4	Above car park entrance	E	F 1	60.0	50.6
5	Adjacent to car park entrance	N	F 1	65.4	55.2
6	Above plant room	N	F 1	66.0	55.7
7	Above cycle storage - left	N	F 1	66.2	55.9
8	Above cycle storage entrance	N	F 1	66.1	55.8
9	Above cycle storage - right	N	F 1	66.9	56.6
10	Above post room	N	F 1	66.6	56.3
1	Adjacent to railway	S	F 2	61.2	53.9
2	Perpendicular to railway	E	F 2	59.1	51.1
3	Adjacent to car park entrance	E	F 2	59.2	50.5
4	Above car park entrance	E	F 2	61.0	51.6
5	Adjacent to car park entrance	N	F 2	65.3	55.0
6	Above plant room	N	F 2	65.9	55.6
7	Above cycle storage - left	N	F 2	66.3	56.0
8	Above cycle storage entrance	N	F 2	66.4	56.0
9	Above cycle storage - right	N	F 2	67.1	56.7
10	Above post room	N	F 2	66.7	56.4
KEY: N = North, S = South, E = East & W = West					

- 7.13 With reference to Table 7.1, it can be seen that, in general there is no change in noise level from the first floor to second floor level on the northern and eastern façades. However this is not true for the southern façade which is adjacent to the railway line where the first floor level is below the top of the concrete retaining wall.
- 7.14 Presented in **Table 7.2** are the predicted façade noise levels of the proposed apartments at the first wholly residential floor level (F 3), four floors above this level (F 6) and at the top floor level of the “Eastern” element. Where the façade is stepped back from the building below, this has been indicated in the table as necessary.



Table 7.2: Predicted façade noise levels at the “Eastern” element – 2021

Receptor Number (App. 3 Ref. No.) and Location		Façade Direction	Floor Level	‘Future’ situation	
				Daytime L _{eq,16hr} dB(A)	Night Time L _{eq,8hr} dB(A)
1	Adjacent to railway line	S	F3	62.1	54.7
		S	F6	61.3	53.7
		S	F11	60.3	52.3
	(private roof terrace)	S	F12	58.0	49.6
2	Perpendicular to railway line	E	F3	60.1	52.1
		E	F6	59.8	51.7
		E	F12	58.9	50.5
3	Adjacent to car park entrance	E	F3	60.1	51.5
		E	F6	59.7	51.2
		E	F11	59.5	50.8
	(stepped back from edge)	E	F12	54.9	45.7
4	Above car park entrance	E	F3	60.9	51.7
		E	F6	60.5	51.5
		E	F12	60.7	51.5
5	Adjacent to car park entrance	N	F3	65.0	54.7
		N	F6	64.6	54.4
		N	F10	63.9	53.8
		N	F11	55.2	45.7
	(private roof terrace)	N	F12	60.4	50.5
6	Above plant room	N	F3	65.7	55.4
		N	F6	65.3	55.0
		N	F11	64.5	54.3
	(private roof terrace)	N	F12	58.5	48.7
7	Overlooking EAST terrace	W	F3	48.9	40.3
		W	F6	58.2	50.5
		W	F12	53.8	44.3
KEY: N = North, S = South, E = East & W = West					

7.15 Presented in **Table 7.3** are the predicted façade noise levels of the proposed apartments within the “Central” element. Apartments at terrace level benefit from the screening effect of the proposed 2 metre high acoustic barrier.



Table 7.3: Predicted façade noise levels at the “Central” element – 2021

Receptor Number (App. 3 Ref. No.) and Location		Façade Direction	Floor Level	'Future' situation	
				Daytime L _{eq,16hr} dB(A)	Night Time L _{eq,8hr} dB(A)
1	Overlooking WEST terrace	S	F 3	49.4	40.7
		S	F 6	59.6	51.5
		S	F 9	60.0	51.5
		S	F 11	60.0	51.4
2	Overlooking WEST terrace	W	F3	49.0	40.3
		W	F6	58.7	50.5
		W	F11	59.3	50.6
3	Overlooking WEST terrace	W	F3	51.2	42.5
		W	F6	61.2	52.8
		W	F10	61.4	52.6
4	Adjacent to railway line	S	F3	62.3	54.5
		S	F6	62.6	54.4
		S	F10	62.3	53.7
5	Adjacent to railway line	S	F3	62.2	54.7
		S	F6	62.2	54.2
		S	F10	61.9	53.5
6	Overlooking EAST terrace	E	F3	47.6	39.7
		E	F6	58.4	51.1
		E	F10	57.5	50.0
7	Overlooking EAST terrace	E	F3	46.1	37.8
		E	F6	56.4	49.0
		E	F11	55.8	48.1
8	Overlooking EAST terrace	S	F 3	48.0	39.4
		S	F 6	57.8	49.9
		S	F 10	58.1	50.0
		S	F 11	58.0	49.8
9	Above cycle storage - left	N	F 3	66.2	55.9
		N	F 6	65.8	55.5
		N	F11	65.3	55.0
10	Above cycle storage entrance	N	F 3	66.3	56.0
		N	F6	66.0	55.7
		N	F11	65.5	55.2
11	Above cycle storage - right	N	F 3	67.1	56.7
		N	F 6	66.8	56.4
		N	F 11	66.2	55.9
KEY: N = North, S = South, E = East & W = West					



- 7.16 With reference to Table 7.3 it can be seen that the façade noise levels to the rear of the east and west terraces are predicted to be between 48 dB (F 3) and 60 dB (F 11) during the daytime. The lower noise levels are at terrace level (R 1, R 2 and R 3 at F 3 and R 6, R 7 and R 8 at F 3). Noise levels are predicted to increase with an increase in height.
- 7.17 Presented in **Table 7.4** are the predicted façade noise levels of the proposed apartments within the “West” tower. Façade noise levels are presented at F 3 (first floor of wholly residential), approximately half way up the building (e.g. F 11) and at the top floor level. Where the façade is stepped back from the building below this has been indicated accordingly.



Table 7.4: Predicted façade noise levels at the “West” tower – 2021

Receptor Number (App. 3 Ref. No.) and Location		Façade Direction	Floor Level	‘Future’ situation	
				Daytime L _{eq,16hr} dB(A)	Night Time L _{eq,8hr} dB(A)
1	West Tower	N	F 3	69.4	58.9
		N	F 12	67.6	57.2
		N	F 21	66.1	55.8
	(private balcony)	N	F 22	60.2	50.3
		N	F 23	63.7	53.6
2	Above main entrance	N	F 3	69.9	59.4
		N	F 12	67.9	57.5
		N	F22	66.4	56.1
3	Above main entrance	W	F 3	71.7	61.2
		W	F 11	69.8	59.5
		W	F 22	67.8	57.5
4	Perpendicular to railway line	W	F 3	71.4	61.0
		W	F 6	70.6	60.3
		W	F 11	69.5	59.2
5	Adjacent to railway line	S	F 3	65.5	56.5
		S	F 6	65.1	56.1
		S	F 11	64.2	54.8
6	(overlooking roof terrace - right)	S	F 12	52.1	42.8
		S	F 13	59.8	50.0
		S	F 17	62.2	52.9
		S	F 22	62.7	53.0
7	(overlooking roof terrace - right)	S	F 23	56.0	46.4
8	(overlooking roof terrace - left)	S	F 3	53.0	43.6
		S	F 5	60.1	50.3
		S	F 12	63.4	53.6
9	Overlooking WEST terrace	S	F 3	46.7	38.5
		S	F 12	56.6	48.6
		S	F 23	60.4	51.0
10	Overlooking Central Element roof (adjacent to WEST terrace)	E	F 11	44.7	36.5
		E	F 16	55.8	47.4
		E	F 23	57.9	48.9
11	Overlooking Central Element roof (adjacent to Napier Road)	E	F 11	53.2	43.7
		E	F 16	59.2	49.7
		E	F 22	58.6	49.3
KEY: N = North, S = South, E = East & W = West					



Free field noise levels in the amenity space

- 7.18 Proposals for the development include two “Roof Terraces” at level three on top of the three storey building. The “Roof Terrace” is approximately 11 metres above ground level. There are also proposals for public amenity space which includes Roof Terraces at level 11 which is on top of the “Central” Element of development. This amenity area is approximately 35 metres above ground level.
- 7.19 The level three “Roof Terraces” will be sheltered from road traffic noise by the proposed buildings. However, the railway noise from the south has the potential to propagate into the Roof Terraces. Therefore, a 2 metre high acoustic barrier is proposed on the southern boundary of the Roof Terraces.
- 7.20 The predicted noise contours for the proposed level three “Roof Terrace” are presented on **Figure 7.4**. The contours were calculated at 12 metres above ground level.
- 7.21 With a 2 metre high acoustic barrier on the southern boundary of the level three roof terraces, noise levels are predicted to be between 55 and 48 dB $L_{Aeq, 16hrs}$ in the WEST terrace and between 51 and 44 dB $L_{Aeq, 16hrs}$ in the EAST terrace.
- 7.22 The level 11 northern roof terrace will be sheltered from railway noise by the proposed buildings. However, the road traffic noise from the north has the potential to propagate into the Roof Terrace.
- 7.23 The level 11 southern roof terraces which overlook the level three roof terraces will be sheltered from road traffic noise by the proposed buildings. However, the railway noise from the south has the potential to propagate into the Roof Terrace.
- 7.24 The predicted noise contours for the proposed level 11 “Roof Terraces” are presented on **Figure 7.5**. The contours were calculated at 36 metres above ground level.
- 7.25 It has been assumed there will be a “safety barrier” at the edge of the level 11 roof terraces in the form of a one metre high dwarf wall, glass screen or similar which has been included in the modelling.



7.26 Within the southern roof terraces, daytime noise levels are predicted to be below 55 dB and there are areas that are below 50 dB.

7.27 Within the northern roof terrace, daytime noise levels are predicted to be below 55 dB with areas below 50 dB. However, towards the northern edge of the terrace noise levels are predicted to be above 55 dB.

Impacts – operation (development generated traffic)

7.28 The effects of the development on the existing environment are considered in terms of modelled traffic data using the CRTN method.

7.29 The CRTN method has been used to predict the noise levels at existing sensitive receptors as a result of additional traffic movements that will be generated by “Committed Development” and the “Proposed Development”. Gateway TSP have determined peak hour traffic flows on the roads around the development which have been factored to 18hr traffic flows using local growth factors. The traffic flow data has been used to calculate the future scenario “Future + Committed Development” (Do Nothing) for 2021 and the future scenario “Future + Committed Development + Proposed Development” (Do Something) scenario for 2021 at representative existing receptor locations. The receptor locations are identified on Figure 4.1 and in **Table 7.5** the results of the calculations are presented.



Table 7.5: Predicted façade noise levels for the “Future + Committed Development” and “Future + Committed Development + Proposed Development” scenarios – 2021

Receptor Location		Façade Direction	Floor Level	“Do Nothing” (2021 + Committed Development)		“Do Something” (2021 + Committed Development + Proposed Development)	
				Daytime Leq,16hr dB(A)	Night Time Leq,8hr dB(A)	Daytime Leq,16hr dB(A)	Night Time Leq,8hr dB(A)
1	22 The Lodge	SW	GF	62.3	52.3	62.7	52.7
		SW	FF	64.4	54.3	64.9	54.7
2	41 Vastern Road	SW	GF	72.8	62.1	72.8	62.1
		SW	FF	73.9	63.2	73.9	63.2
		SW	SF	73.8	63.1	73.8	63.1
3	Rising Sun PH	NE	GF	70.8	60.2	70.8	60.2
		NE	FF	72.1	61.4	72.1	61.5
4	North Reading Bridge House	E	GF	54.7	45.2	55.1	45.5
		E	FthF	58.9	49.2	59.3	49.4
		E	TpF	58.8	49.3	59.0	49.3
		S	GF	69.6	59.1	69.7	59.2
		S	FthF	72.1	61.5	72.1	61.5
		S	TpF	70.7	60.2	70.7	60.2
		W	GF	68.7	58.3	68.8	58.3
		W	FthF	72.5	61.8	72.5	61.9
		W	TpF	71.5	60.9	71.5	61.0
5	King's Meadow House	S	GF	58.6	48.9	58.7	49.0
		S	TF	61.5	51.6	61.7	51.7
		S	SxF	63.0	53.0	63.0	53.0
6	Napier Court	W	GF	60.7	51.2	61.1	51.6
		W	FF	62.9	53.2	63.3	53.6
		N	GF	68.3	57.8	68.8	58.3
		N	FF	68.1	57.6	68.5	58.1
KEY: N – north, E – east, S – south, W – west, GF – ground floor, FF – first floor, SF – second floor, TF – third floor, FthF – fifth floor, SxF – sixth floor and TpF – top floor,							

7.30 From Table 7.5 it can be seen that at noise levels are predicted to change by 0.5 dB or less at all the sensitive receptors that would be affected by development generated traffic.



Impact and Significance

- 7.31 To assess the impact it is necessary to use the criteria outlines in Section 2.13 to 2.15. The impact from the development is determined by calculating the noise level difference between the “Do nothing” (without development) and “Do something” (Future + Committed Development + Proposed Development) scenarios to identify the change in noise level at each receptor location. Outlined in the following tables is the impact assessment for the receptors outside the development for the “Do something” scenario.
- 7.32 To assess the significance of noise effects it is necessary to use the criteria outlined in Table 2.5. All the receptors are residential and therefore considered of ‘high’ sensitivity. Where the ‘impact’ of changes in noise level is considered ‘Moderate’ or ‘Major’, the cells in the tables have been shaded dark grey to indicate where mitigation may be required. Presented in **Table 7.6** are the results from the impact assessment.



Table 7.6: Impact assessment for development generated traffic at sensitive receptor locations

Receptor Location		Façade Direction		Daytime		Night Time	
			Floor Level	Change in Noise Level, dB(A)	Magnitude of Impact	Change in Noise Level, dB(A)	Magnitude of Impact
“Do nothing” to “Do Something”							
1	22 The Lodge	SW	GF	0.4	Negligible	0.4	Negligible
		SW	FF	0.5	Negligible	0.4	Negligible
2	41 Vastern Road	SW	GF	0.0	No change	0.0	No change
		SW	FF	0.0	No change	0.0	Negligible
		SW	SF	0.0	No change	0.0	Negligible
3	Rising Sun PH	NE	GF	0.0	No change	0.0	No change
		NE	FF	0.0	No change	0.1	Negligible
4	North Reading Bridge House	E	GF	0.4	Negligible	0.3	Negligible
		E	FthF	0.4	Negligible	0.2	Negligible
		E	TpF	0.2	Negligible	0.0	Negligible
		S	GF	0.1	Negligible	0.1	Negligible
		S	FthF	0.0	No change	0.0	No change
		S	TpF	0.0	No change	0.0	No change
		W	GF	0.1	Negligible	0.0	No change
		W	FthF	0.0	Negligible	0.1	Negligible
		W	TpF	0.0	No change	0.1	Negligible
5	King’s Meadow House	S	GF	0.2	Negligible	0.1	Negligible
		S	TF	0.2	Negligible	0.1	Negligible
		S	SxF	0.0	No change	0.0	No change
6	Napier Court	W	GF	0.4	Negligible	0.4	Negligible
		W	FF	0.4	Negligible	0.4	Negligible
		N	GF	0.5	Negligible	0.5	Negligible
		N	FF	0.4	Negligible	0.5	Negligible
KEY: N – north, E – east, S – south, W – west, GF – ground floor, FF – first floor, SF – second floor, TF – third floor, FthF – fifth floor, SxF – sixth floor and TpF – top floor.							

7.33 As can be seen in Table 7.6, there is predicted to be “No Change”, a “Negligible” (0.1 to 0.9 dB – daytime) and a “Negligible” (0.1 to 2.9 dB – night time) noise impact at all the receptors during the daytime and the night time.

7.34 Receptors 1, 2 and 3 are residential dwellings (Rising Sun PH first floor) which is considered “high” sensitivity to noise (refer to Table 2.4). The magnitude of impact is predicted to be “No Change” or “Negligible” therefore significance of considered “Neutral” or “Slight” (refer to Table 2.5).



7.35 Where the receptors are at offices, the sensitivity to changes in noise is considered “Medium” (refer to Table 2.4). The magnitude of impact is predicted to be “No Change” or “Negligible” therefore significance of considered “Neutral” or “Neutral/Slight” (refer to Table 2.5).



8.0 MITIGATION MEASURES

Introduction

- 8.1 As mentioned previously, in order to consider the effects of the proposals once constructed it is necessary to split the assessment into constraints and impacts. Constraints deal with the effect of the existing environment on the development and impacts deal with the effect of the development on the existing environment.

Constraints on development

- 8.2 From Figures 4.2 and 4.3 it can be seen that adjacent to Vastern Road and King's Meadow Road noise levels are above 63 dB during the daytime and above 55 dB during the night time and decrease slightly within the site. The aforementioned noise levels have been calculated at 1.5 metres above ground level, however the lowest proposed residential apartments are 5 metres above ground level up to the penthouse apartments which are approximately 72 metres above ground level.
- 8.3 In 2021, noise levels across the development site are predicted to be slightly higher than the existing noise levels (2016) due to changes in traffic flows on the local highway network. The predicted noise profile of the development site is presented on Figure 7.1 (daytime) and Figure 7.2 (night time).
- 8.4 In 2021, noise from the railway line will be reduced because of the electrification of the Great Western Railway Line. In any case, the assessment has considered a worst-case scenario.
- 8.5 To reduce noise levels to below the internal and external noise levels presented in the WHO guidelines, BS 8233 and local planning policy a commensurate level of mitigation is required.
- 8.6 Internal noise levels of any habitable room during the night time period should not exceed 30 dB to comply with BS 8233 and the WHO guidelines. During the daytime, internal noise levels in living rooms/bedrooms and dining areas should not exceed 35 dB and 40 dB respectively to also comply with BS 8233. With reference to Table 7.1, Table 7.2, Table 7.3 and Table 7.4 there are façades with levels above 50 dB and 45 dB during the daytime and night time.



- 8.7 There are many ways for sound to enter a building. The routes are through the roof, the doors and the main route is through the windows. If the roof is built to current Building Regulations and of sufficient mass it will provide an adequate barrier to the passage of sound. For example, a flat timber joist roof, asphalt on boarding, 12 mm plasterboard ceiling with thermal insulation has a weighted sound reduction of approximately 45 dB. Doors with adequate mass and minimal gaps between the door and door frame can provide sound reduction of approximately 35 dB when fitted to manufacturers' specification.
- 8.8 With regard to windows, thermal double glazed units should be fitted in accordance with Building Regulations as a minimum standard. Units are normally of the configuration 6 – 12 – 6 (glass, air gap and glass) with a weighted sound reduction (R_w) of approximately 33 dB. Presented in **Table 8.1** are sound reduction values for window systems utilising various air gap and window thickness.

Table 8.1: Example Window Systems

Material	Configuration glass/air gap/glass (mm)	Total Thickness (mm)	Sound Reduction (dB)
Sealed Unit	6/12/6	28	33
Sealed Unit	4/12/12	28	36
Sealed Unit	6/12/10	28	37
Laminated glass	6/12/11	29	40
Laminated glass	10/12/16	38	42
Laminated glass	13/12/13	38	45
Sealed Unit	6/20/12	38	41

- 8.9 Presented in the following paragraphs are the highest predicted façade noise levels during the daytime and night time. Also the noise levels of the south façades overlooking the railway are shown. The required sound reduction index (SRI) of a façade to achieve an internal daytime noise level ($L_{eq,16hr}$) in living rooms and bedrooms and an internal night time ($L_{eq,8hr}$) noise level in bedrooms has been calculated for the first level of apartments, a level of apartments approximately half way up each tower and the top floor of apartments. Also considered is the required SRI of a façade to mitigate maximum noise levels ($L_{max,F}$) from railway traffic during the night time.



- 8.10 The layout of the building can be split up into four segments for this purpose: The main base building, the eastern element, the central element and the west tower.

Main Base Building

- 8.11 The highest façade noise level at the main base building during the night time (2300 – 0700) is predicted to be 56.7 dB at second floor (F 2) apartments, above the cycle storage on the **northern** façade (refer to Table 7.1 and Appendix 4) which faces Napier Road. To achieve internal noise level of 30 dB ($L_{Aeq,8hr}$) during the night time a sound reduction index (SRI) of 26.7 dB would be required ($56.7 - 30 = 26.7$).
- 8.12 During the daytime (0700 – 2300), the highest façade noise levels is predicted to be 67.1 dB at second floor (F 2), above the cycle storage on the **northern** façade (refer to Table 7.1 and Appendix 4) which faces Napier Road. To achieve reasonable resting conditions in bedrooms and living rooms during the daytime an SRI of 32.1 dB would be required ($67.1 - 35 = 32.1$).
- 8.13 The façades closest to the railway line are predicted to experience a night time ($L_{eq,8hr}$) noise levels of 46.2 dB (South) and 47.4 dB (East) at the first floor (F 1) apartments and 53.9 dB (South) and 51.1 dB (East) at the second floor (F 2) apartments. However, a maximum noise level ($L_{max,F}$) of 90.9 dB was recorded which needs to be taken into account when determining internal noise levels. To achieve in internal noise level of 30 dB ($L_{Aeq,8hr}$) and 45 dB ($L_{max,F}$) during the night time an SRI of 45.9 dB would be required ($90.9 - 45 = 45.9$).

Eastern Element

- 8.14 The highest façade noise level during the night time (2300 – 0700 hours) is predicted to be 55.4 dB at the third floor of apartments (F 3) above the 'plant room' on the northern façade of the Eastern element (refer to Table 7.2 and Appendix 4) which overlooks Napier Road. To achieve an internal noise level of 30 dB ($L_{Aeq,8hr}$) during the night time an SRI of 25.4 dB would be required. Façade noise levels are predicted to decrease with an increase in height and an SRI of 23 dB would be required half way up and an SRI of 24.3 dB at the top floor below the roof terrace. At the roof terrace (F 12), an SRI of 18.7 dB would be required.



- 8.15 During the daytime (0700 – 2300), the highest façade noise levels is predicted to be 65.7 dB at the third floor of apartments (F 3) above the ‘plant room’ on the northern façade of the Eastern element (refer to Table 7.2 and Appendix 4) which overlooks Napier Road. To achieve reasonable resting conditions in bedrooms and living rooms during the daytime an SRI of 30.7 dB would be required ($65.7 - 35 = 30.7$). Façade noise levels are predicted to decrease with an increase in height and an SRI of 30.3 dB would be required half way up and an SRI of 29.5 dB at the top floor below the roof terrace. At the roof terrace (F 11), an SRI of 23.5 dB would be required.
- 8.16 The façade closest to the railway line is predicted to experience a night time ($L_{eq,8hr}$) noise level of 54.7 dB at the third floor of apartments. However, a maximum noise level ($L_{max,F}$) of 90.9 dB was recorded which needs to be taken into account when determining internal noise levels. To achieve in internal noise level of 30 dB ($L_{Aeq,8hr}$) and 45 dB ($L_{max,F}$) during the night time an SRI of 45.9 dB would be required ($90.9 - 45 = 45.9$). Taking into account the reduction in façade noise level with an increase in height on the southern façade, an SRI of 45.1 dB would be required half way up and an SRI of 43.7 dB at the top floor.

Central Element

- 8.17 The highest façade noise level during the night time (2300 – 0700 hours) is predicted to be 56.7 dB at the third floor of apartments (F 3) above the ‘cycle store’ on the northern façade of the Central Element (refer to Table 7.3 and Appendix 4) which overlooks Napier Road. To achieve an internal noise level of 30 dB ($L_{Aeq,8hr}$) during the night time an SRI of 26.7 dB would be required. Façade noise levels are predicted to decrease with an increase in height and an SRI of 26.4 dB would be required half way up and an SRI of 25.9 dB at the top floor.



- 8.18 During the daytime (0700 – 2300), the highest façade noise levels is predicted to be 67.1 dB at the third floor of apartments (F 3) above the 'cycle store' on the northern façade of the Central Element (refer to Table 7.3 and Appendix 4) which overlooks Napier Road. To achieve reasonable resting conditions in bedrooms and living rooms during the daytime an SRI of 32.1 dB would be required ($67.1 - 35 = 32.1$). Façade noise levels are predicted to decrease with an increase in height and an SRI of 31.8 dB would be required half way up and an SRI of 31.2 dB at the top floor.
- 8.19 The façade closest to the railway line is predicted to experience a night time ($L_{eq,8hr}$) noise level of 54.7 dB at the third floor of apartments. However, a maximum noise level ($L_{max,F}$) of 90.9 dB was recorded which needs to be taken into account when determining internal noise levels. To achieve in internal noise level of 30 dB ($L_{Aeq,8hr}$) and 45 dB ($L_{max,F}$) during the night time an SRI of 45.9 dB would be required ($90.9 - 45 = 45.9$). Taking into account the reduction in façade noise level with an increase in height on the southern façade, an SRI of 45.1 dB would be required half way up and an SRI of 44.0 dB at the top floor.

West Tower

- 8.20 The highest façade noise level during the night time (2300 – 0700 hours) is predicted to be 61.2 dB at the third floor of apartments (F 3) above the 'main entrance' on the western façade of the West Tower (refer to Table 7.4 and Appendix 4) which overlooks Vastern Road. To achieve an internal noise level of 30 dB ($L_{Aeq,8hr}$) during the night time an SRI of 31.2 dB would be required ($61.2 - 30 = 31.2$). Façade noise levels are predicted to decrease with an increase in height and an SRI of 29.5 dB would be required half way up and an SRI of 27.5 dB at the top floor.
- 8.21 During the daytime (0700 – 2300), the highest façade noise levels is predicted to be 71.7 dB at the third floor of apartments (F 3) above the 'main entrance' on the western façade of the West Tower (refer to Table 7.4 and Appendix 4) which overlooks Vastern Road. To achieve reasonable resting conditions in bedrooms and living rooms during the daytime an SRI of 36.7 dB would be required ($71.7 - 35 = 36.7$). Façade noise levels are predicted to decrease with an increase in height and an SRI of 34.8 dB would be required half way up the tower and an SRI of 33.8 dB at the top floor.



Mitigation

- 8.22 From the above, it can be seen that with the appropriate combination of wall and window, internal noise levels will meet BS 8233 and WHO guidelines on all the façade on all the floors of the proposed development with the windows closed.
- 8.23 If any of the windows or doors is open in the façade, the sound reduction for the façade containing the window or door will be reduced to approximately 15 dB. The effect of having the window or door open is a reduction in transmission loss through the façade and results in a higher internal noise level within the room.
- 8.24 Façades with a noise level of greater than 45 dB during the night time and 50 dB during the daytime and a window or door open will not meet the BS 8233 or WHO guidelines for internal noise levels in bedrooms and sitting rooms.
- 8.25 Where façade noise levels are above 45 dB (night time) or 50 dB (daytime), another method of ventilating the rooms will have to be provided without opening the windows or doors.
- 8.26 Proposals for ventilating the apartments is through the use of a mechanical ventilation and heat recovery system (MVHR) which negates the need to open the window to provide background ventilation to the apartment. MVHR systems are available which have multiple settings which can provide different flow rates at the occupant's choice or at pre-set temperatures or humidity levels.
- 8.27 Windows can be opened for purge ventilation or at the occupants' choice.
- 8.28 Public and private terraces/balconies throughout the proposed development benefit from noise protection by purpose built acoustic screens (public terraces) or glass/Perspex barriers (private terraces/balconies).

Outside Amenity Area (Roof Terraces)

- 8.29 From paragraphs 7.19 to 7.28 and illustrated on Figures 7.4 and 7.5 it can be seen that noise levels in the "Roof Terraces" of the proposed space have areas which meet the BS 8233 and WHO guidelines noise levels for outside amenity space.



- 8.30 Adjacent to the railway line the noise levels would be higher than the BS 8233 and WHO guidelines with no mitigation. However, the construction of a physical acoustic barrier at the southern boundary of the EAST and WEST “Roof Terraces” would shield the area in the shadow zone of the barrier, ensuring that levels are below the recommended guidelines.
- 8.31 At the level 11 roof terraces it has been assumed that a one metre high “safety barrier” is proposed and will provide mitigation against noise to these areas. If required, a barrier of greater height could be incorporated into the design which would provide even greater mitigation against road traffic noise and railway noise.
- 8.32 It should be reiterated that the assessment is a “worst-case scenario”. As a result of the electrification of the Great Western Main Line, a significant proportion of trains will be quieter than the GWR diesel trains assessed.

Impacts – Construction

- 8.33 Best practicable means will be used to minimise construction noise through the implementation of the recommendations set out in BS 5228. In particular, the following noise mitigation measures would be implemented:
- Proper use of plant with respect to minimising noise emissions and regular maintenance will be required. All vehicles and mechanical plant will be fitted with effective exhaust silencers and will be maintained in good efficient order;
 - The use of inherently quiet plant where appropriate – all major compressors and generators will be ‘sound reduced’ models fitted with properly lined and sealed acoustic covers, which will be kept closed whenever the machines are in use, and all ancillary pneumatic percussive tools will be fitted with mufflers or silencers of the type recommended by the manufacturers;
 - Machines in intermittent use will be shut down in the intervening periods between work or throttled down to a minimum;
 - All ancillary plant such as generators and pumps will be positioned so as to cause minimum noise disturbance, and where necessary, acoustic enclosures will be provided;
 - Where practicable the use of noisy plant will be limited to core daytime periods;



- Channels of communication will be established between the contractor/developer, Local Authority and residents;
- A site representative will be appointed responsible for matters relating to noise;
- Typical levels of noise will be monitored during critical periods and at sensitive locations;
- A 2m high solid site hoarding along the site boundaries will be erected where practical and feasible;
- Localised noise barriers will be erected as necessary around items such as generators or heavy duty compressors;
- Construction compounds will be laid out so as to minimise noise impacts to neighbouring noise sensitive receptors, by locating noisy operations well away from receptors and using on-site structures and materials to screen noise where practicable and necessary.

Impacts – Additional Traffic Movements

- 8.34 In paragraphs 7.24 and 7.25 it was demonstrated that additional traffic movements resulting from the proposed development are predicted to result in “No Change” or “Negligible” increases in noise levels during the daytime and night time. The significance of adverse noise effects is considered “Neutral” or “Slight” (refer to Table 2.5) at these locations, it is therefore not necessary to include any additional mitigation measures associated with the additional traffic movements.

Sample Mitigation

- 8.35 If the roof is built to current Building Regulations, it will provide an adequate barrier to the passage of sound. With regard to windows, thermal double glazed units should be fitted in accordance with Building Regulations as a minimum standard. Units are normally of the configuration 6 – 12 – 6 (glass, air gap and glass) with a weighted sound reduction (R_w) of approximately 33 dB.
- 8.36 Acoustically attenuated background/trickle vents are available with sound reduction properties equal to and greater than levels provided by windows and doors. For example, window mounted and wall mounted trickle vents are available with a sound reduction of approximately 42 dB and 38 dB respectively. Window trickle vents can be mounted in the window frame or above or below the window and provide adequate cross ventilation within the room or hallway.



- 8.37 Within the development there are a couple of areas where apartments are located adjacent to public areas. These are apartment 01.12 which is adjacent to the “lobby” area, duplex 10.09 which is adjacent to and above the proposed “cinema room”, and apartments 10.16 and 10.16 which are adjacent to the northern roof terrace.
- 8.38 The walls and floors between the apartment bedrooms and the adjacent public areas will require adequate sound reduction to ensure daytime resting (35 dB $L_{Aeq,t}$) and night time sleeping (30 dB $L_{Aeq,8hr}$) conditions are not met. Particular attention will need to be paid to the design of the wall and floor between duplex 10.09 and the “cinema room”.
- 8.39 With regard to mitigation to noise levels in outside amenity areas, the construction of the proposed buildings, boundary treatments such as brick walls and fences help reduce noise levels in these areas.
- 8.40 The acoustic barrier proposed at the south of the East and West roof terraces between the terrace and the railway line should be a minimum of 2 metres high to avoid diffraction. The barrier is expected to be acrylic and toughened glass to reflect sound. If appropriate and in accordance with the design of the roof terrace, additional modular sections of the barrier could be added to contain absorptive properties.



9.0 SUMMARY AND CONCLUSIONS

- 9.1 Stuart Michael Associates Limited (SMA) has been engaged by Lochailort Reading Limited (the Applicant) to undertake a noise assessment of the proposed development Thames Quarter, Reading. This noise assessment has considered the constraints on the proposed development and potential impacts from development generated traffic. Also considered are impacts from the development construction.
- 9.2 The constraints on the development and the impacts from development generated traffic have been assessed using the computer model SoundPLAN which incorporates the CRTN and CRN method. Also considered are the potential impacts from construction activities and these have been assessed using the method detailed in BS 5228.
- 9.3 From on-site observations, the dominant noise sources in the local area are from road traffic on the local highway network and the railway line. A “worst case scenario” has been assessed. The Great Western Main Line to the south of the site is undergoing electrification. Once complete, the line will operate with a significant proportion of quieter trains than the current diesel trains which have been assessed.
- 9.4 A noise level survey was undertaken within the development site at three locations. Three consecutive hours of road traffic noise were recorded adjacent to the A329 Vastern Road and at the site entrance. Railway noise was recorded on top of the existing parking structure. The noise survey was undertaken to determine the existing noise profile of the site and to verify the noise modelling.
- 9.5 The calculation method detailed in CRTN and CRN have been used to assess the changes in noise levels due to development generated traffic. Resultant noise levels within the development site have been assessed against WHO guidelines, British Standard 8233 and local planning policy. The base year for the assessment is 2016 and the future year is 2021 (five years after submission of the planning application).



- 9.6 From the results of the noise level surveys and the computer modelling it is evident that during the daytime and night time, noise levels within development site are above 55 dB and 45 dB respectively and a commensurate level of mitigation will be required.
- 9.7 Within the development site, an assessment has been undertaken of the predicted noise levels at all of the façades and at all floor levels.
- 9.8 For assessment, the proposed development has been split into four elements: Main Base Building, Eastern Element, Central Element and West Tower. Within the four elements, noise levels are predicted to range from 44.7 dB during the daytime and 36.5 dB during the night time (F 11 of the West Tower, east façade overlooking Central Element roof) to 71.7 dB during the daytime and 61.2 dB during the night time (F 3 of the West Tower, western façade overlooking Vastern Road).
- 9.9 Maximum noise levels were recorded within the development site during the daytime and night time periods. The maximum noise level recorded during the night was 90.9 dB ($L_{MAX,F}$) and this has been taken into account when calculating the appropriate Sound Reduction Index (SRI) for south facing façades.
- 9.10 Where façade noise levels are above 50 dB during the daytime and 45 dB during the night time and internal ($L_{MAX,F}$) levels are predicted to be above 45 dB for reasonable number of times during the night, mitigation measures are proposed to ensure internal noise levels meet BS 8233:2014, WHO guidelines and local planning policy.
- 9.11 The use of appropriate glazed windows with an SRI of between 33 dB (6/12/6 sealed unit) and 45 dB (13/12/13 laminated glass) in a wall with an SRI of 55 dB results in appropriate façade sound reduction. Incorporating an appropriate MVHR system will result in internal noise to within BS 8233 and WHO daytime and night internal noise guideline levels.

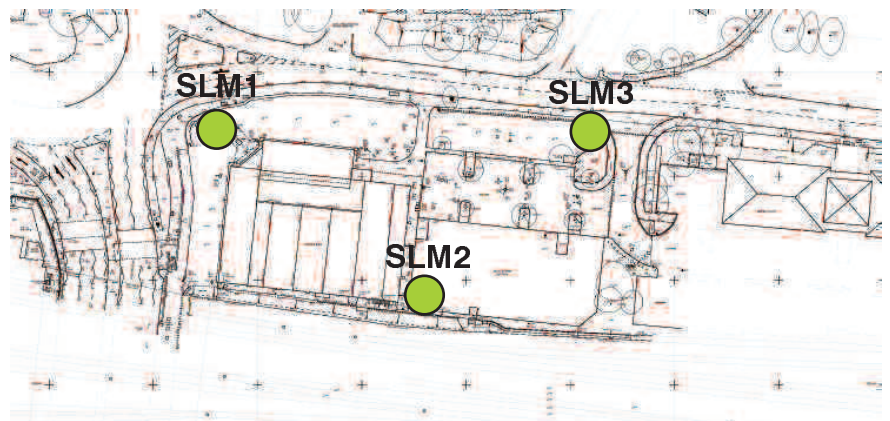
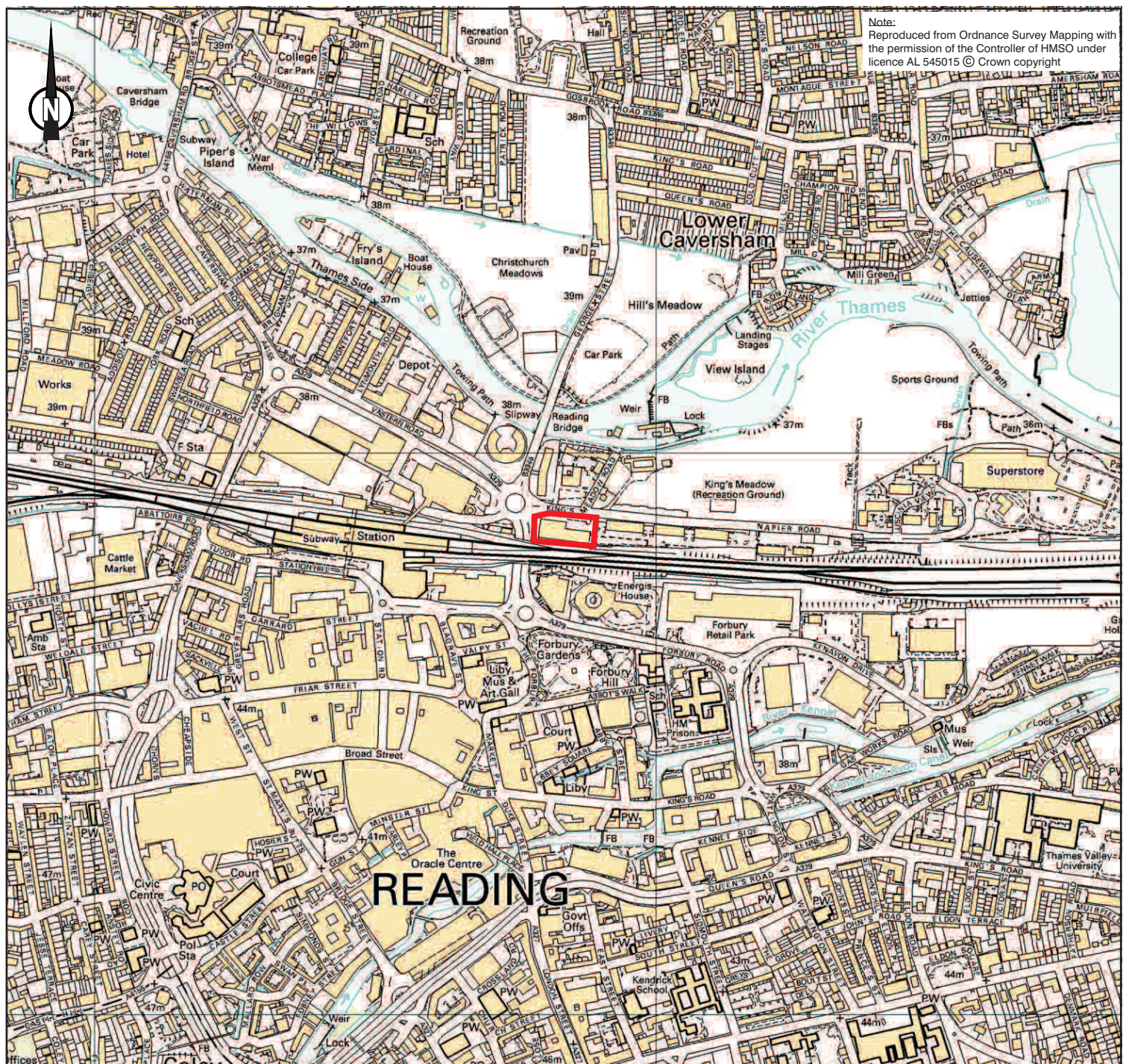


- 9.12 Within the development site, free field noise levels have been calculated in the level three and level 11 “Roof Terraces”. A physical acoustic barrier on the southern façade of the level three terraces will ensure that noise levels will be less than 50 dB(A) during the daytime. The incorporation of a one metre high “safety barrier” such as a dwarf wall (or similar) at the level 11 roof terraces will help reduce noise levels within these areas to below 55 dB(A) during the daytime. Increasing the height of the one metre high “safety barrier” will reduce the noise levels further within the level 11 roof terraces.
- 9.13 Balconies throughout the development will be affected by road traffic and rail traffic noise due to the sites proximity to the local roads and the railway line. The construction of a barrier on the balconies, such as glass balustrades or similar, will help shield the private amenity areas from road and rail traffic noise and a reduction of up to 10 dB to those private amenity areas is possible.
- 9.14 Outside of the development site a noise impact assessment has been undertaken at a number of receptors which have a “High” sensitivity to noise. The receptors are located at residential dwellings adjacent to King’s Meadow Road/Napier Road, A329 Vastern Road, and Forbury Road.
- 9.15 Façade noise levels were determined for the base year 2016, the future year 2021 “Do Nothing” (Future + Committed Development) and 2021 “Do Something” (Future + Committed Development + Proposed Development). The magnitude of change and significance of noise effects were determined at all the receptors from the “Do Nothing” to the “Do Something” scenarios.
- 9.16 There is predicted to be a “Negligible” increase or “No Change” in noise levels at all of the façade included in the impact assessment. A receptor with a “High” sensitivity to changes in noise level which experiences a “Negligible” increase in noise level is considered of “Slight” significance.
- 9.17 The results from the BS 5228 assessment indicate that the predicted noise levels at the four sensitive receptors adjacent to the site will be above the threshold limits during the four main phases of construction which is considered significant. Demolition and site clearance of the former BMW showroom is complete, while the car park is still operational. Mitigation will be required to minimise the construction noise impacts.



- 9.18 Noise from some construction activities will be audible at the nearest sensitive receptor locations, but if Best Practical Means (BPM) is implemented then noise impacts can be minimised. It should be noted that construction impacts are temporary and people are generally more tolerant of higher noise levels if they know they are only going to be of a temporary duration.
- 9.19 Based on the results of the noise assessment, it has been concluded that with appropriate mitigation, internal and external noise levels meet the national and local standards and are acceptable for future residents of the proposed Thames Quarter development.

FIGURES



Legend



Site Boundary

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JOB TITLE

Thames Quarter
Reading

DRAWING TITLE

**SITE AND
MEASUREMENT
LOCATION PLAN**

FIGURE 1.1

SCALE:

NTS @ A4

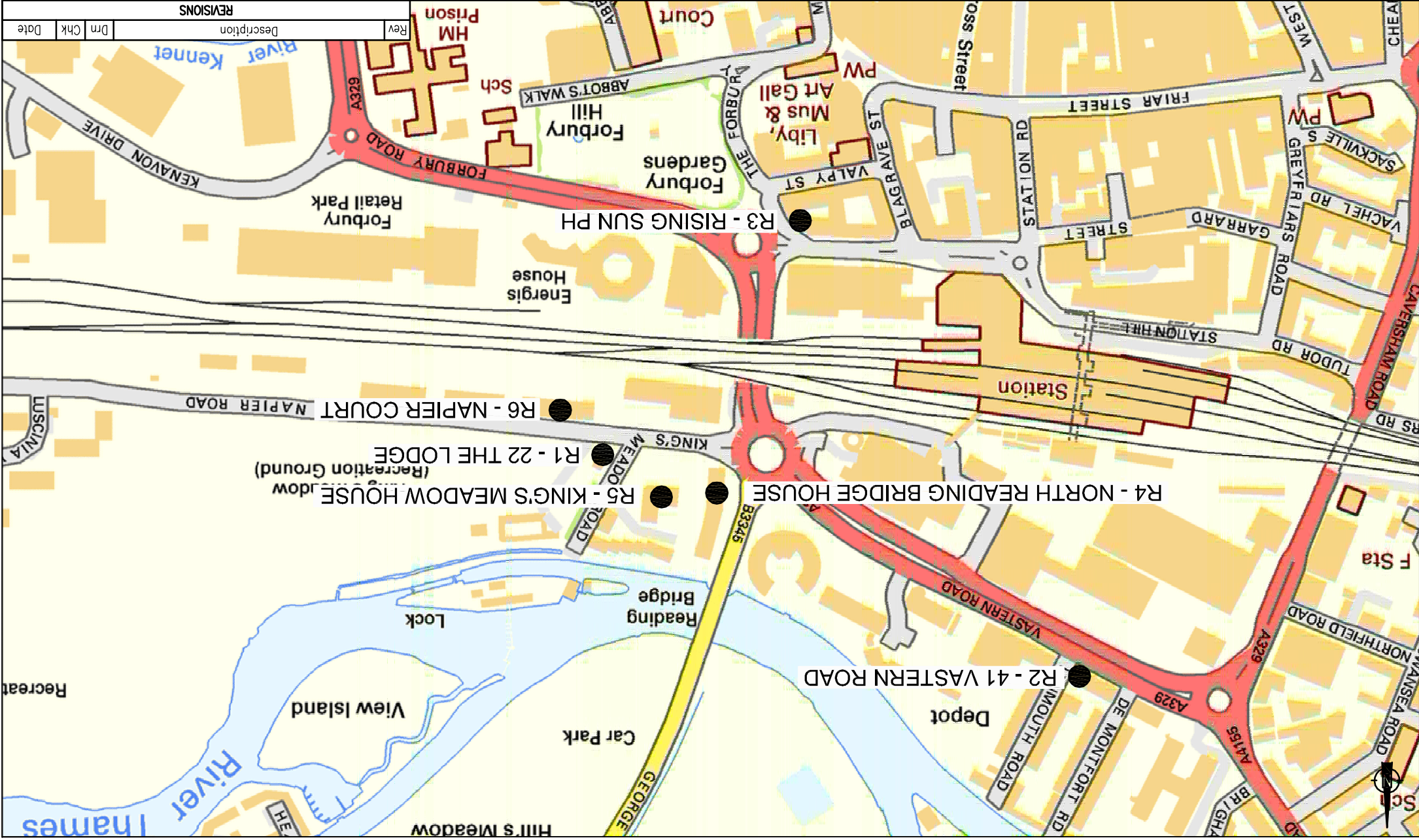
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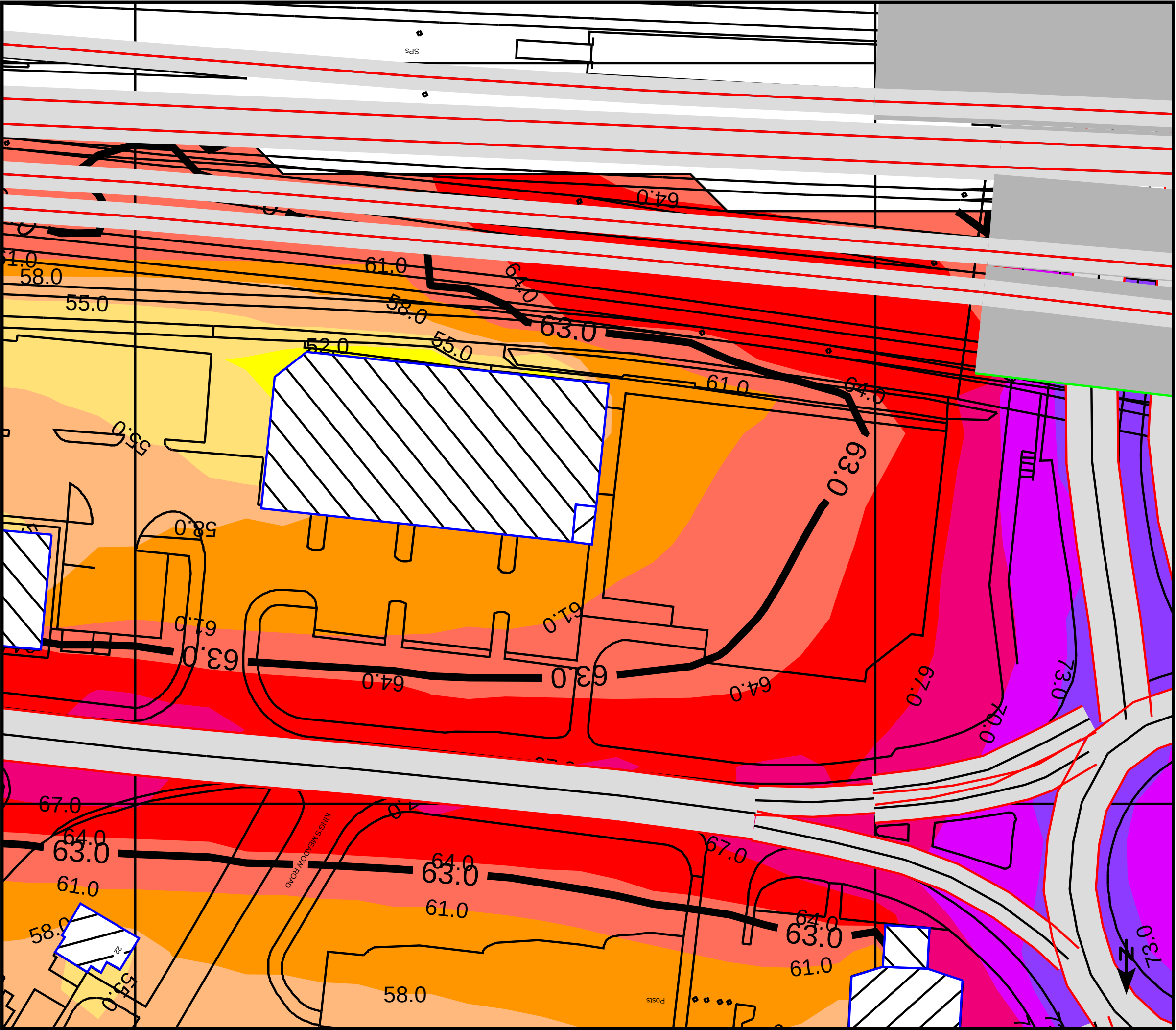
THAMES QUARTER READING RECEPTOR LOCATION PLAN

DATE MAY 2016 DRAWN JPM CHECKED SWA
ISSUE CHECKBOX

DRAWING No. FIGURE 4.1 .
REV. SCALE NTS @ A4

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Signs and symbols

Line

Area

Road axis

Emission line

Surface

Central reservation

Wall

Main building

Auxiliary building

Elevation point

Point receiver

63 dB(A)

Ground absorption

Railway axis

Bridge

Inside tunnels

Emission line

Surface

Line

Area

Road axis

Emission line

Surface

Central reservation

Wall

Main building

Auxiliary building

Elevation point

Point receiver

63 dB(A)

Ground absorption

Railway axis

Bridge

Inside tunnels

Emission line

Surface

Noise level

Leq,16hr

in dB(A)

37 < 40 < 43 < 46 < 49 < 52 < 55 < 58 < 61 < 64 < 67 < 70 < 73 < 76 < 79

37 < 40 < 43 < 46 < 49 < 52 < 55 < 58 < 61 < 64 < 67 < 70 < 73 < 76 < 79

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Job Title:

Thames Quarter Reading

Client:

Lochailort Investments Limited

Drawing Title:

2016 - Noise Profile Daytime (0700 - 2300)

Drawn:

WAH

Checked:

SWA

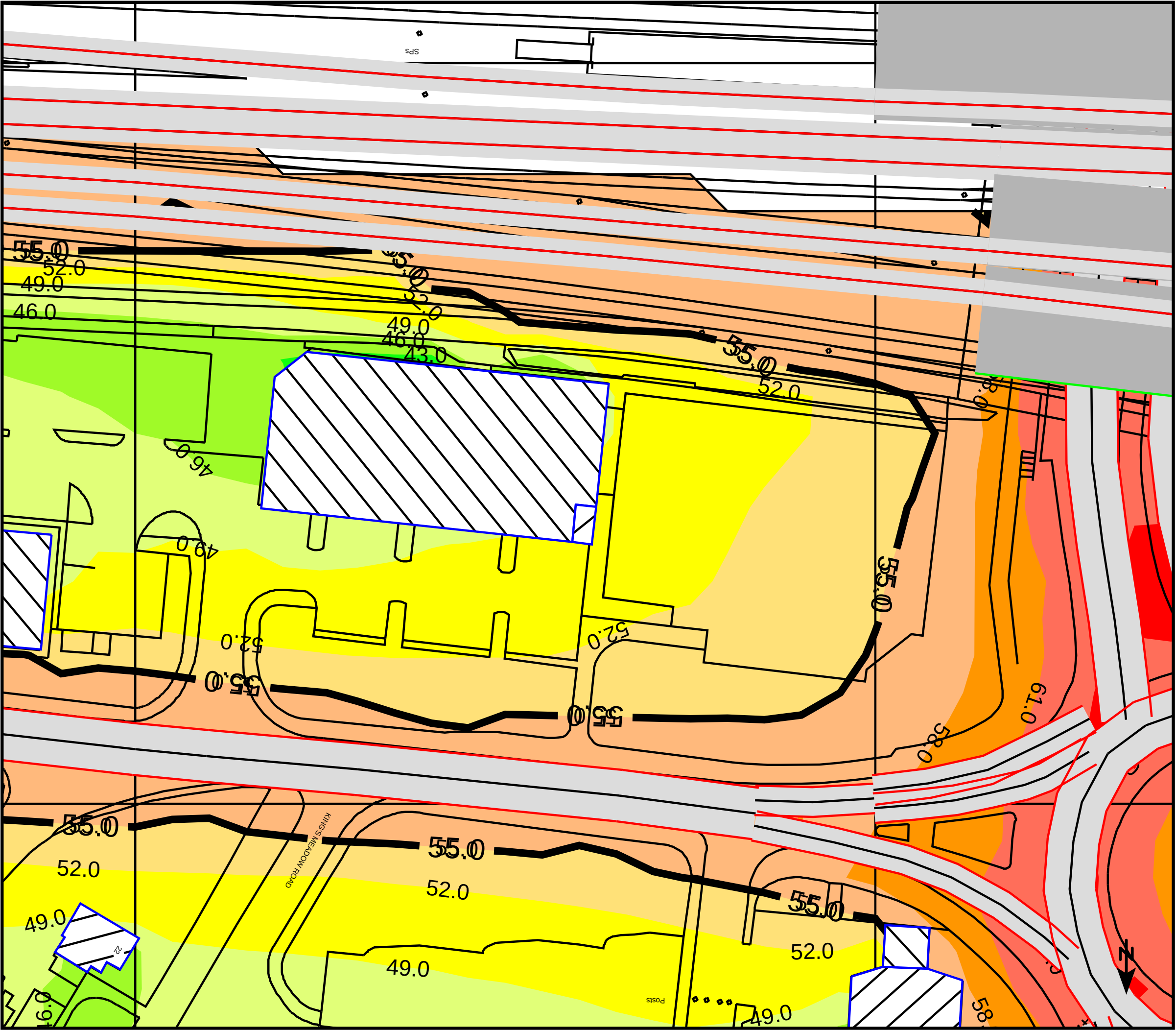
Date:

November 2016

Scale:

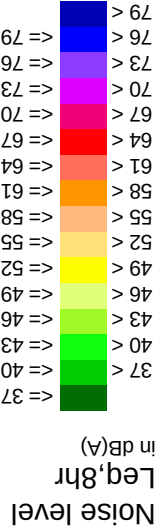
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Figure: Figure 4.2



Signs and symbols

- Line
- Area
- Road axis
- Emission line
- Surface
- Central reservation
- Wall
- Main building
- Auxiliary building
- Elevation point
- Point receiver
- 55 dB(A)
- Ground absorption
- Railway axis
- Bridge
- Inside tunnels
- Emission line
- Surface



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Job Title:

Thames Quarter
Reading

Client:

Lochailort Investments Limited

Drawing Title:

2016 - Noise Profile
Night Time (2300 - 0700)

Drawn:

WAH

Scale:

1:500

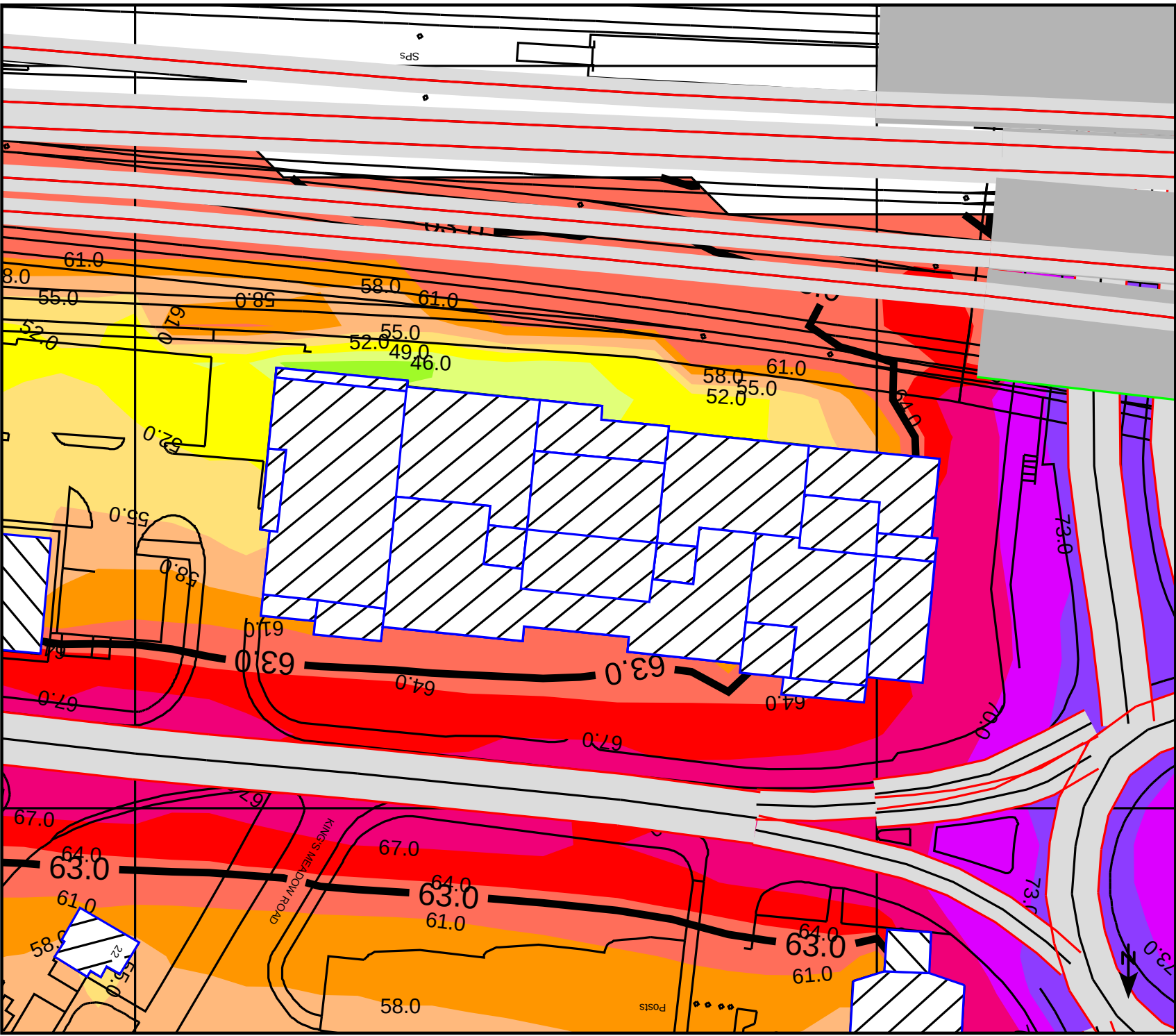
Checked:

SWA

Date:

November 2016

Figure 4.3





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Signs and symbols

- Line
- Area
- Road axis
- Emission line
- Surface
- Central reservation
- Wall
- Main building
- Auxiliary building
- Elevation point
- Point receiver
- 63 dB(A)
- Ground absorption
- Railway axis
- Bridge
- Inside tunnels

Noise level
Leq,16hr
in dB(A)

79 <	76 <	73 <	70 <	67 <	64 <	61 <	58 <	55 <	52 <	49 <	46 <	43 <	40 <	37 <
79	76	73	70	67	64	61	58	55	52	49	46	43	40	37

Job Title: Thames Quarter Reading

Client: Lochalort Investments Limited

Drawing Title: 2021 - Noise Profile Daytime (0700 - 2300)

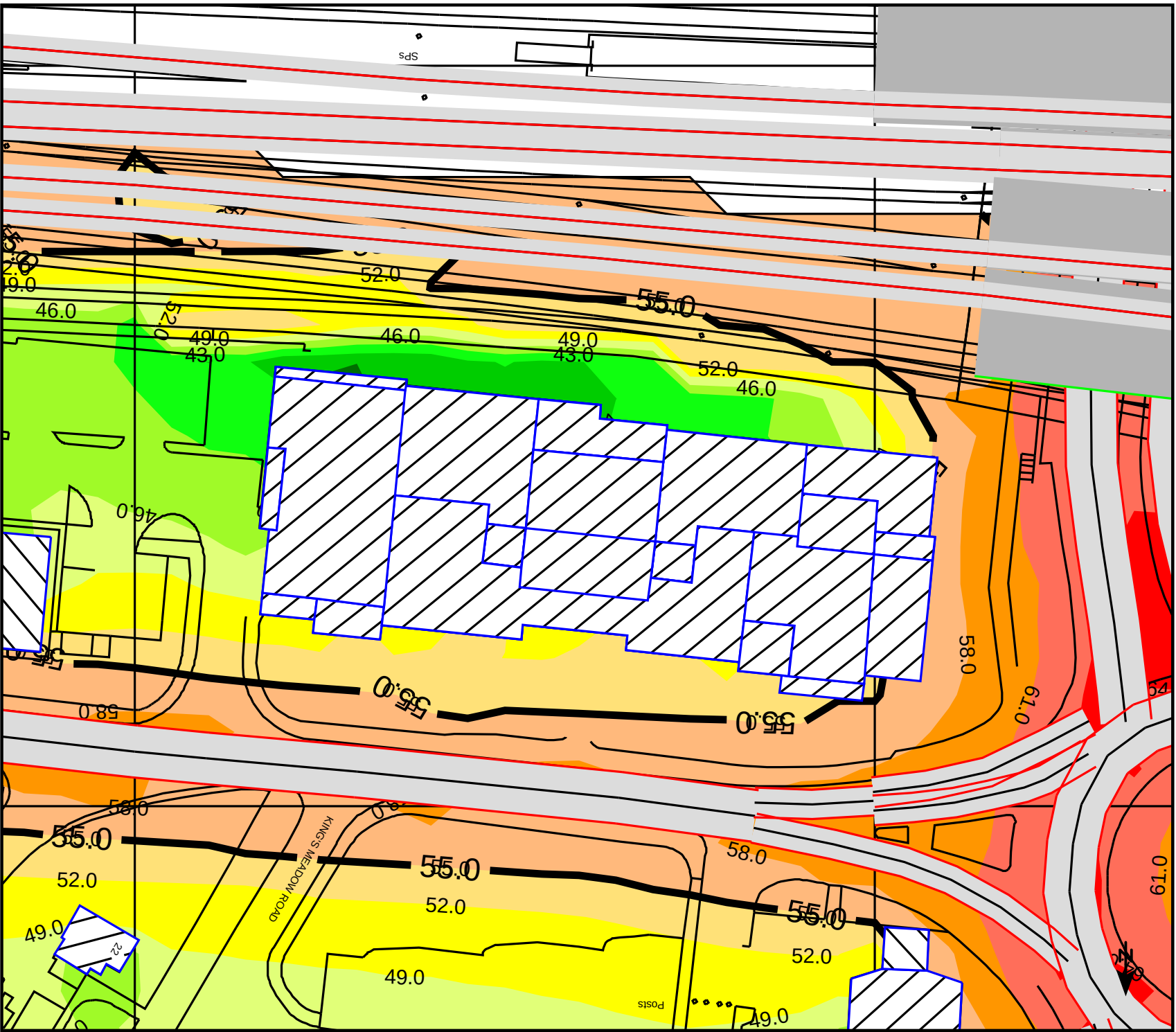
Drawn: JPM

Scale: 1:500

Checked: SWA

Date: November 2016

Figure: Figure 7.1



Signs and symbols

Line	Area	Road axis	Emission line	Surface	Central reservation	Wall	Main building	Auxiliary building	Elevation point	Point receiver	55 dB(A)	Ground absorption	Railway axis	Bridge	Inside tunnels
------	------	-----------	---------------	---------	---------------------	------	---------------	--------------------	-----------------	----------------	----------	-------------------	--------------	--------	----------------

Noise level

79 <	76 <	73 <	70 <	67 <	64 <	61 <	58 <	55 <	52 <	49 <	46 <	43 <	40 <	37 <
in dB(A)	Leq,8hr	in dB(A)	in dB(A)	in dB(A)	in dB(A)	in dB(A)	in dB(A)	in dB(A)	in dB(A)	in dB(A)	in dB(A)	in dB(A)	in dB(A)	in dB(A)

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Job Title: Thames Quarter Reading
Client: Lochalort Investments Limited
Drawing Title: 2021 - Noise Profile Night Time (2300 - 0700)

Drawn: JPM
Scale: 1:500
Checked: SWA
Date: November 2016

Figure: Figure 7.2

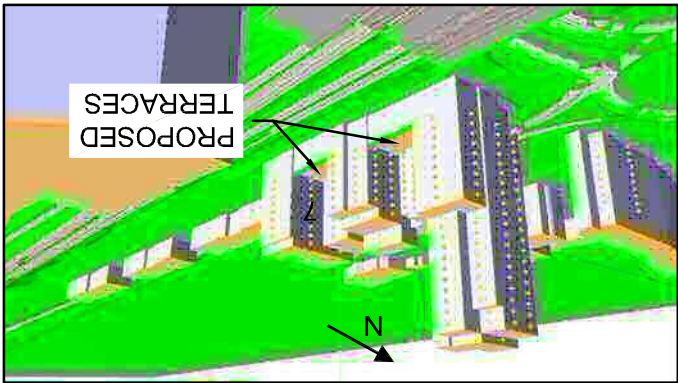
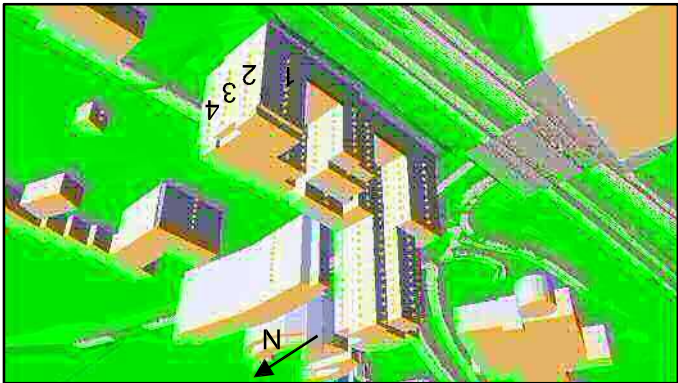
THAMES QUARTER
READING

DEVELOPMENT RECEPTOR
LOCATION PLAN

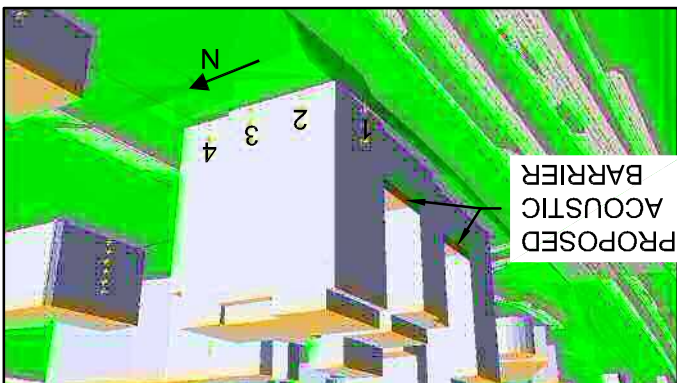
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DRAWING NO. FIGURE 7.3		REV	SCALE	NTS	@ A3
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Preliminary	Approval		Tender	Const.	
REVISIONS					
Rev	Description	Drn	Chk	Date	

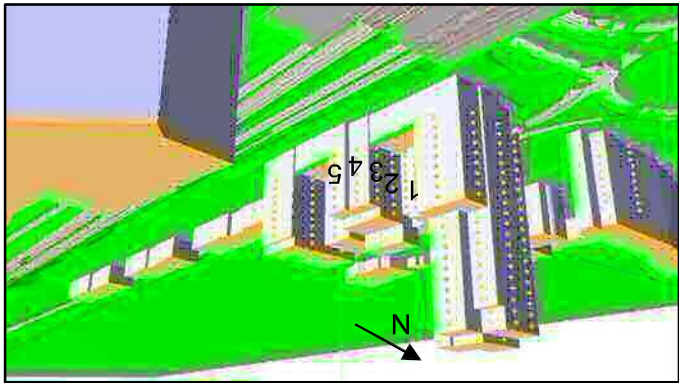
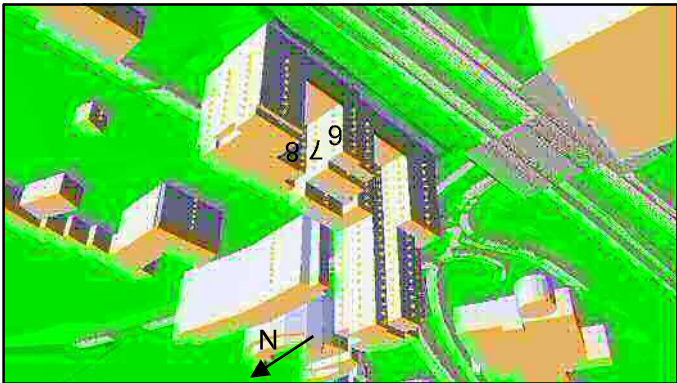
EASTERN ELEMENT



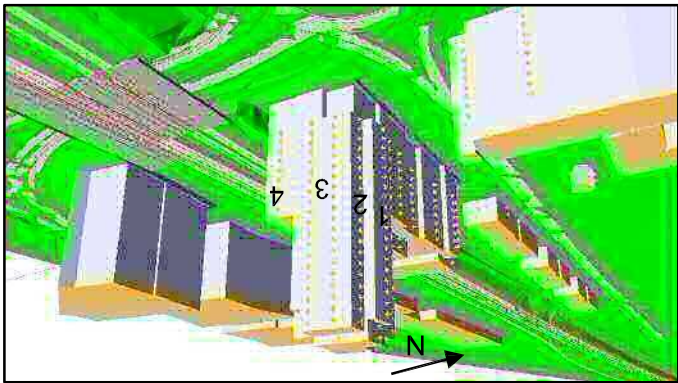
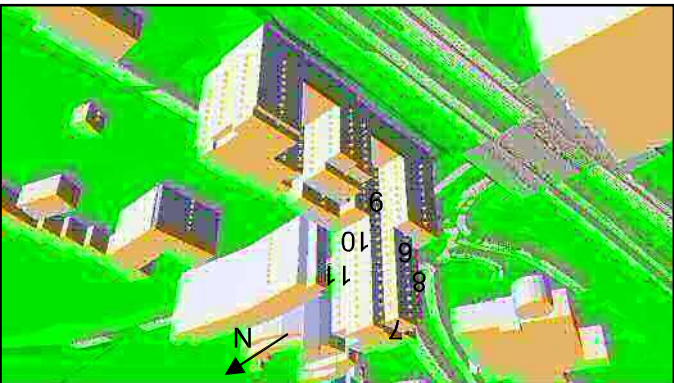
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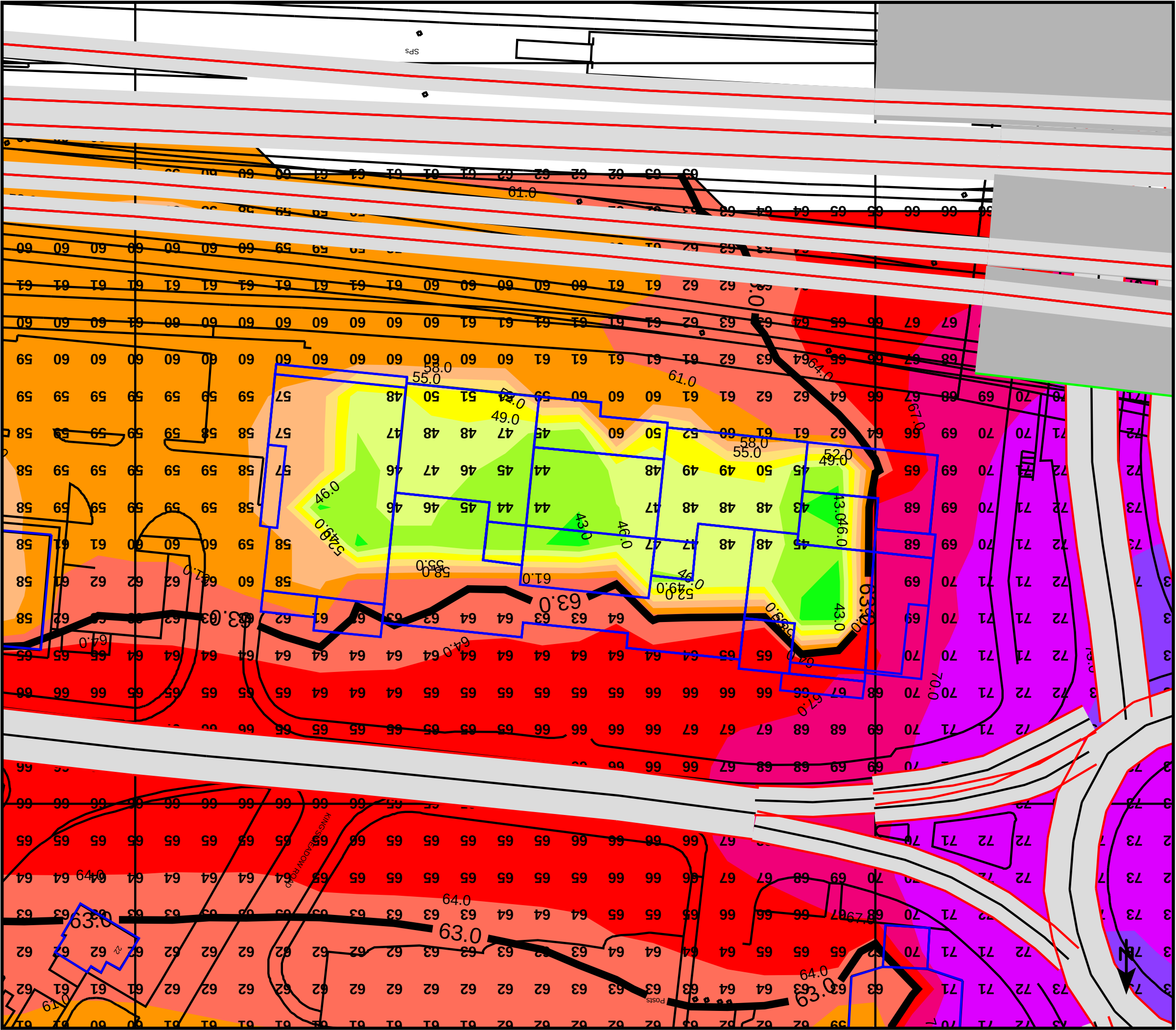


CENTRAL ELEMENT



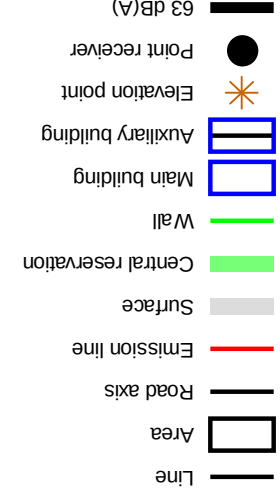
WEST TOWER





Signs and symbols

- Line
- Area
- Road axis
- Emission line
- Surface
- Central reservation
- Wall
- Main building
- Auxiliary building
- Elevation point
- Point receiver
- 63 dB(A)
- Ground absorption
- Railway axis
- Bridge
- Inside tunnels



Job Title: Thames Quarter Reading

Client: Lochalort Investments Limited

Drawing Title: 2021 - Noise Profile - Roof Garden Daytime (0700 - 2300) 12m Above Ground Level

Drawn: JPM

Checked: SWA

Date: November 2016

Figure: Figure 7.4

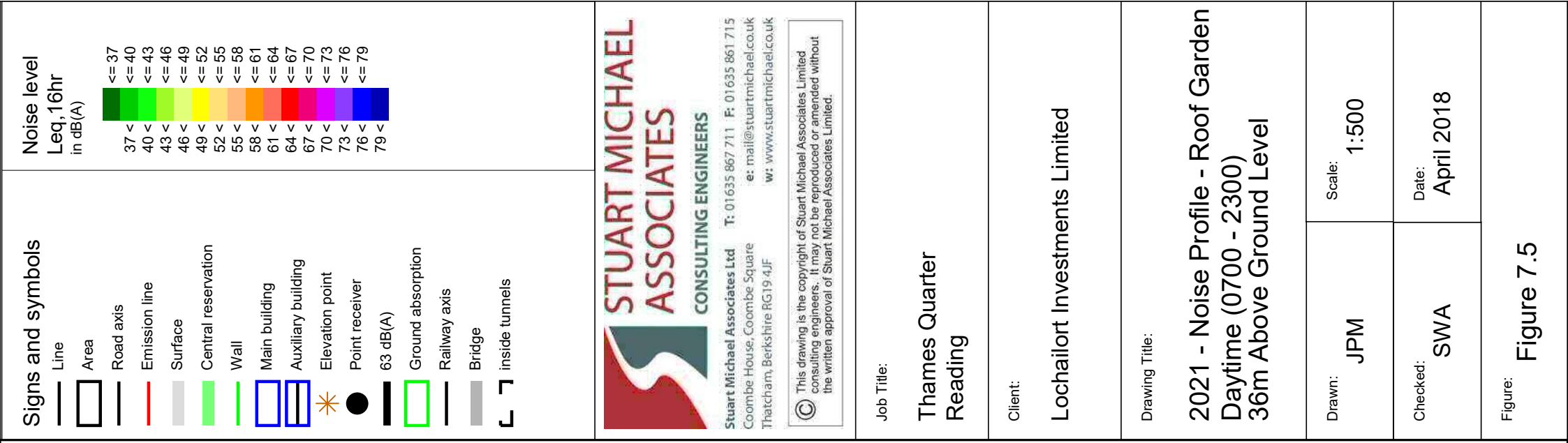
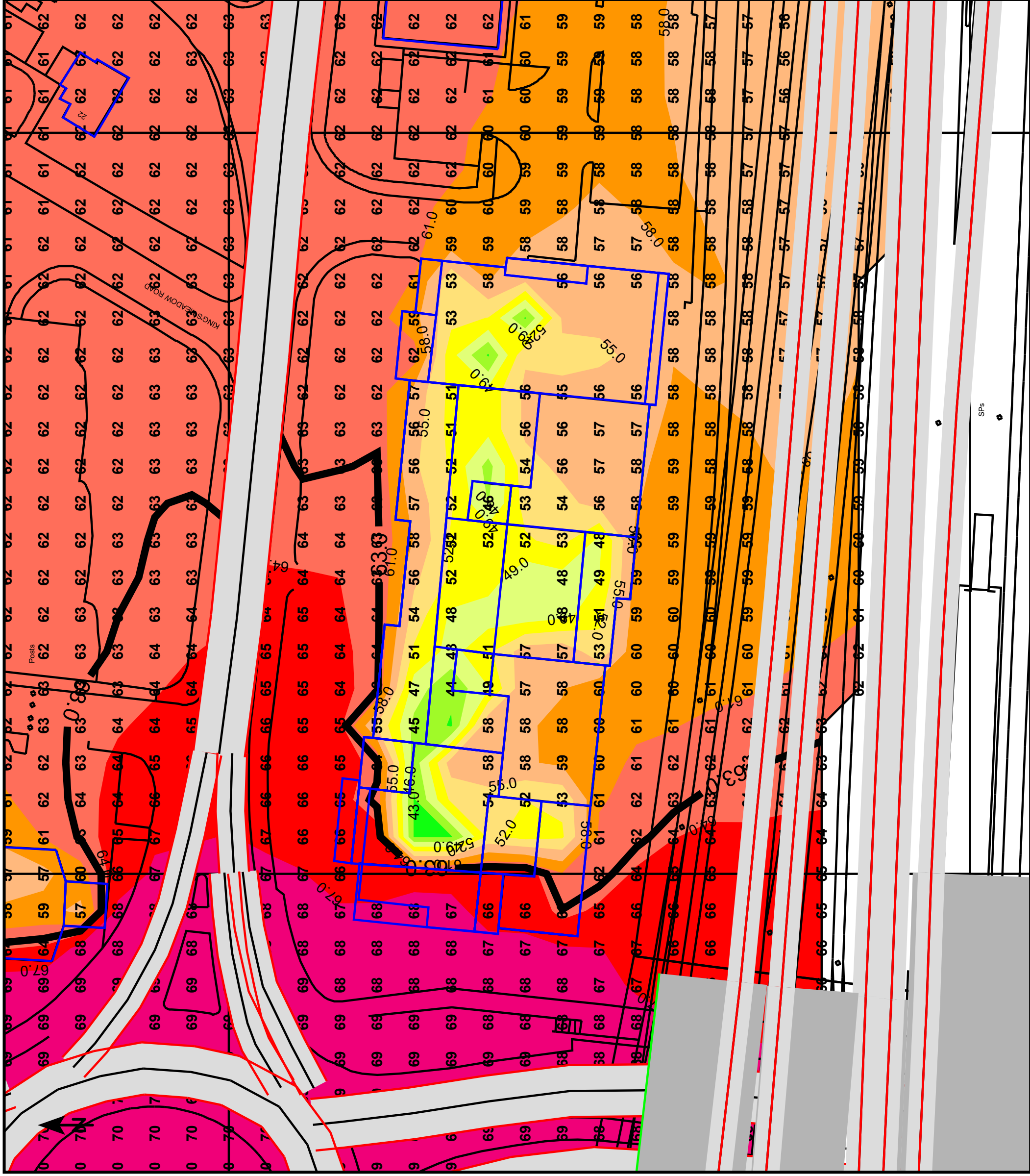


Figure: **Figure 7.5**

APPENDICES

Appendix 1 – Façade Noise Levels at Sensitive Receptors

APPENDIX 1

2016 Facade Noise Levels

No.	Floor	Name	Usage	Direction	Leq,16hr		Leq,8hr	
					dB(A)			
1	1	22 King's Meadow Road	GR	NE	54.9		45.3	
1	2	22 King's Meadow Road	GR	NE	57.1		47.4	
2	1	22 King's Meadow Road	GR	SE	61.2		51.3	
2	2	22 King's Meadow Road	GR	SE	63.4		53.3	
3	1	22 King's Meadow Road	GR	SW	62.1		52.1	
3	2	22 King's Meadow Road	GR	SW	64.2		54.1	
4	1	22 King's Meadow Road	GR	NW	57.5		47.8	
4	2	22 King's Meadow Road	GR	NW	59.7		49.9	
5	1	41 to 51 Vastern Road	GR	NE	47.4		38.3	
5	2	41 to 51 Vastern Road	GR	NE	49.9		40.5	
5	3	41 to 51 Vastern Road	GR	NE	53.9		44.3	
6	1	41 to 51 Vastern Road	GR	SW	72.6		61.9	
6	2	41 to 51 Vastern Road	GR	SW	73.7		63.0	
6	3	41 to 51 Vastern Road	GR	SW	73.6		62.9	
7	1	EA - King's Meadow House	GR	S	58.5		48.8	
7	2	EA - King's Meadow House	GR	S	60.4		50.6	
7	3	EA - King's Meadow House	GR	S	61.5		51.6	
7	4	EA - King's Meadow House	GR	S	62.1		52.2	
7	5	EA - King's Meadow House	GR	S	62.7		52.7	
7	6	EA - King's Meadow House	GR	S	63.1		53.1	
8	1	Napier Court - left	GR	W	60.6		51.1	
8	2	Napier Court - left	GR	W	62.7		53.1	
9	1	Napier Court - left	GR	N	68.0		57.6	
9	2	Napier Court - left	GR	N	67.8		57.4	
10	1	Napier Court - left	GR	S	56.0		48.6	
10	2	Napier Court - left	GR	S	57.8		50.2	
11	1	Reading Bridge House	GR	S	69.5		59.0	
11	2	Reading Bridge House	GR	S	71.9		61.3	
11	3	Reading Bridge House	GR	S	72.2		61.6	
11	4	Reading Bridge House	GR	S	72.1		61.5	
11	5	Reading Bridge House	GR	S	71.9		61.3	
11	6	Reading Bridge House	GR	S	71.6		61.0	
11	7	Reading Bridge House	GR	S	71.3		60.8	
11	8	Reading Bridge House	GR	S	71.0		60.5	
11	9	Reading Bridge House	GR	S	70.7		60.2	
11	10	Reading Bridge House	GR	S	70.4		60.0	
12	1	Reading Bridge House	GR	E	54.6		45.2	
12	2	Reading Bridge House	GR	E	56.7		47.1	
12	3	Reading Bridge House	GR	E	57.8		48.1	
12	4	Reading Bridge House	GR	E	58.5		48.8	
12	5	Reading Bridge House	GR	E	59.1		49.3	
12	6	Reading Bridge House	GR	E	59.3		49.6	
12	7	Reading Bridge House	GR	E	59.4		49.6	
12	8	Reading Bridge House	GR	E	59.4		49.6	
12	9	Reading Bridge House	GR	E	59.4		49.7	
12	10	Reading Bridge House	GR	E	59.4		49.7	
13	1	Reading Bridge House	GR	W	68.4		58.0	
13	2	Reading Bridge House	GR	W	71.3		60.7	
13	3	Reading Bridge House	GR	W	72.1		61.5	
13	4	Reading Bridge House	GR	W	72.2		61.6	
13	5	Reading Bridge House	GR	W	72.1		61.5	
13	6	Reading Bridge House	GR	W	72.0		61.4	
13	7	Reading Bridge House	GR	W	71.8		61.2	
13	8	Reading Bridge House	GR	W	71.6		61.0	
13	9	Reading Bridge House	GR	W	71.4		60.8	
13	10	Reading Bridge House	GR	W	71.1		60.6	
14	2	Rising Sun PH	GR	NE	71.9		61.3	

Appendix 2 – Construction Noise Assessment

APPENDIX 2

BS 5228 Construction Noise Calculations

No Mitigation

Receptors adjacent to the site	Ambient Noise Level (dB(A)) at receptor	Distance from source to receptor (metres)								
		Specific construction noise level	20	30	40	50	60	70	80	
Napier Court	60	Total noise level (dB(A))	77	73	71	69	67	67	66	
22 The Lodge	62		77	73	71	69	68	67	66	
King's Meadow House	58		77	73	71	69	67	66	65	
Reading Bridge House	69		77	74	73	72	71	71	71	

Earthworks

Receptors adjacent to the site	Ambient Noise Level (dB(A)) at receptor	Distance from source to receptor (metres)	20	30	40	50	60	70	80
			82	76	74	72	70	69	68
Napier Court	60	Total noise level (dB(A))	82	77	75	73	71	70	69
22 The Lodge	62		83	77	75	73	71	70	69
King's Meadow House	58		82	76	75	73	71	70	69
Reading Bridge House	69		83	77	76	74	73	72	72

Construction

Receptors adjacent to the site	Ambient Noise Level (dB(A)) at receptor	Distance from source to receptor (metres)	20	30	40	50	60	70	80
		Specific construction noise level	81	77	75	73	71	70	69
Napier Court	60	Total noise level (dB(A))	81	77	75	73	72	71	70
22 The Lodge	62		81	77	75	73	72	71	70
King's Meadow House	58		81	77	75	73	71	70	69
Reading Bridge House	69		81	78	76	75	73	73	72

Landscaping

Receptors adjacent to the site	Ambient Noise Level (dB(A)) at receptor	Distance from source to receptor (metres)	20	30	40	50	60	70	80
		Specific construction noise level	68	68	66	64	62	61	60
Napier Court	60	Total noise level (dB(A))	68	68	67	65	64	63	63
22 The Lodge	62		69	69	67	66	65	64	64
King's Meadow House	58		68	68	66	65	63	62	62
Reading Bridge House	69		72	72	71	70	70	70	70

BS 5228 Construction Noise Calculations

With Mitigation

Receptors adjacent to the site	Ambient Noise Level (dB(A)) at receptor	Distance from source to receptor (metres)	Demolition							
			20	30	40	50	60	70	80	
Napier Court	60	Total noise level (dB(A))	66	66	64	62	60	59	58	
22 The Lodge	62		67	67	66	64	63	63	62	
King's Meadow House	58		68	68	66	65	64	64	63	
Reading Bridge House	69		67	67	65	64	62	62	61	
			71	71	71	70	70	70	70	

Earthworks

Receptors adjacent to the site	Ambient Noise Level (dB(A)) at receptor	Distance from source to receptor (metres)	20	30	40	50	60	70	80
			72	66	64	62	60	59	58
Napier Court	60	Total noise level (dB(A))	73	67	66	64	63	63	62
22 The Lodge	62		73	68	66	65	64	64	63
King's Meadow House	58		73	67	65	64	62	62	61
Reading Bridge House	69		74	71	71	70	70	70	70

Construction

Receptors adjacent to the site	Ambient Noise Level (dB(A)) at receptor	Distance from source to receptor (metres)	20	30	40	50	60	70	80
			71	67	65	63	61	60	59
Napier Court	60	Total noise level (dB(A))	72	68	66	65	64	63	63
22 The Lodge	62		72	68	67	65	64	64	64
King's Meadow House	58		71	68	66	64	63	62	62
Reading Bridge House	69		73	71	71	70	70	70	70

Landscaping

Receptors adjacent to the site	Ambient Noise Level (dB(A)) at receptor	Distance from source to receptor (metres)	20	30	40	50	60	70	80
			58	58	56	54	52	51	50
Napier Court	60	Total noise level (dB(A))	62	62	61	61	61	61	61
22 The Lodge	62		63	63	63	62	62	62	62
King's Meadow House	58		61	61	60	59	59	59	59
Reading Bridge House	69		70	70	70	70	69	69	69

Appendix 3 – Development Façade Noise Levels - 2021

Main Base Building (Parking Level)									
Receptor Number	Façade Direction	Floor	Future Situation		Receptor Number	Façade Direction	Floor	Future Situation	
			Daytime Leq,16hr	Night Time Leq,8hr				Daytime Leq,16hr	Night Time Leq,8hr
1	S	F 1	53.8	46.2	1	S	F 2	61.2	53.9
2	E	F 1	55.9	47.4	2	E	F 2	59.1	51.1
3	E	F 1	57.8	48.9	3	E	F 2	59.2	50.5
4	E	F 1	60.0	50.6	4	E	F 2	61.0	51.6
5	N	F 1	65.4	55.2	5	N	F 2	65.3	55.0
6	N	F 1	66.0	55.7	6	N	F 2	65.9	55.6
7	N	F 1	66.2	55.9	7	N	F 2	66.3	56.0
8	N	F 1	66.1	55.8	8	N	F 2	66.4	56.0
9	N	F 1	66.9	56.6	9	N	F 2	67.1	56.7
10	N	F 1	66.6	56.3	10	N	F 2	66.7	56.4

Note - there are no proposed apartments at Ground Floor (GF) level

Eastern Element									
Receptor Number	Façade Direction	Floor	Future Situation		Receptor Number	Façade Direction	Floor	Future Situation	
			Daytime Leq,16hr	Night Time Leq,8hr				Daytime Leq,16hr	Night Time Leq,8hr
1	S	F 3	62.1	54.7	4	E	F 8	60.7	51.6
1	S	F 4	61.9	54.5	4	E	F 9	60.9	51.7
1	S	F 5	61.6	54.1	4	E	F 10	60.8	51.6
1	S	F 6	61.3	53.7	4	E	F 11	60.7	51.5
1	S	F 7	61.0	53.3	4	E	F12	60.6	51.4
1	S	F 8	60.7	52.9	5	N	F 3	65.0	54.7
1	S	F 9	60.6	52.6	5	N	F 4	64.8	54.6
1	S	F 10	60.3	52.3	5	N	F 5	64.7	54.5
1	S	F 11	58.0	49.6	5	N	F 6	64.6	54.4
1	S	F12	57.7	49.3	5	N	F 7	64.4	54.2
2	E	F 3	60.1	52.1	5	N	F 8	64.2	54.0
2	E	F 4	60.2	52.2	5	N	F 9	63.9	53.8
2	E	F 5	60.0	52.0	5	N	F 10	55.2	45.7
2	E	F 6	59.8	51.7	5	N	F 11	60.4	50.5
2	E	F 7	59.6	51.5	5	N	F12	60.1	50.2
2	E	F 8	59.3	51.2	6	N	F 3	65.7	55.4
2	E	F 9	59.1	50.9	6	N	F 4	65.6	55.3
2	E	F 10	59.0	50.6	6	N	F 5	65.5	55.2
2	E	F 11	58.9	50.5	6	N	F 6	65.3	55.0
2	E	F12	58.8	50.4	6	N	F 7	65.1	54.8
3	E	F 3	60.1	51.5	6	N	F 8	64.9	54.6
3	E	F 4	60.0	51.5	6	N	F 9	64.7	54.5
3	E	F 5	59.9	51.4	6	N	F 10	64.5	54.3
3	E	F 6	59.7	51.2	6	N	F 11	58.5	48.7
3	E	F 7	59.6	51.1	6	N	F12	58.2	48.5
3	E	F 8	59.5	50.9	7	W	F 3	48.9	40.3
3	E	F 9	59.5	50.8	7	W	F 4	54.7	46.5
3	E	F 10	59.5	50.8	7	W	F 5	58.1	50.4
3	E	F 11	59.5	50.8	7	W	F 6	58.2	50.5
3	E	F12	59.4	50.7	7	W	F 7	58.3	50.4
4	E	F 3	60.9	51.7	7	W	F 8	58.3	50.2
4	E	F 4	60.8	51.7	7	W	F 9	58.3	50.1
4	E	F 5	60.7	51.6	7	W	F 10	58.3	50.0
4	E	F 6	60.5	51.5	7	W	F 11	58.4	50.0
4	E	F 7	60.6	51.5	7	W	F12	58.3	49.9

Note - First Floor (F 1) and Second Floor (F 2) are covered in the "Main Base Building"

Central Element									
Receptor Number	Façade Direction	Floor	Future Situation		Receptor Number	Façade Direction	Floor	Future Situation	
			Daytime Leq,16hr	Night Time Leq,8hr				Daytime Leq,16hr	Night Time Leq,8hr
1	S	F 3	49.4	40.7	7	E	F 3	46.1	37.8
1	S	F 4	54.9	46.2	7	E	F 4	50.5	42.2
1	S	F 5	58.5	50.4	7	E	F 5	54.7	47.2
1	S	F 6	59.6	51.5	7	E	F 6	56.4	49.0
1	S	F 7	59.8	51.6	7	E	F 7	56.3	48.8
1	S	F 8	59.9	51.5	7	E	F 8	56.1	48.6
1	S	F 9	60.0	51.5	7	E	F 9	55.9	48.3
1	S	F 10	60.0	51.4	7	E	F 10	55.8	48.1
1	S	F 11	60.0	51.4	7	E	F 11	55.7	48.0
2	W	F 3	49.0	40.3	8	S	F 3	48.0	39.4
2	W	F 4	54.8	46.2	8	S	F 4	52.7	43.9
2	W	F 5	57.9	49.8	8	S	F 5	55.6	47.5
2	W	F 6	58.7	50.5	8	S	F 6	57.8	49.9
2	W	F 7	58.9	50.6	8	S	F 7	58.1	50.2
2	W	F 8	59.1	50.6	8	S	F 8	58.1	50.1
2	W	F 9	59.2	50.6	8	S	F 9	58.1	50.0
2	W	F 10	59.3	50.6	8	S	F 10	58.0	49.8
2	W	F 11	59.3	50.6	8	S	F 11	57.9	49.7
3	W	F 3	51.2	42.5	9	N	F 3	66.2	55.9
3	W	F 4	60.2	52.4	9	N	F 4	66.1	55.8
3	W	F 5	61.0	52.8	9	N	F 5	65.9	55.6
3	W	F 6	61.2	52.8	9	N	F 6	65.8	55.5
3	W	F 7	61.3	52.8	9	N	F 7	65.7	55.4
3	W	F 8	61.4	52.7	9	N	F 8	65.5	55.2
3	W	F 9	61.4	52.6	9	N	F 9	65.4	55.1
3	W	F 10	61.4	52.6	9	N	F 10	65.3	55.0
4	S	F 3	62.3	54.5	9	N	F 11	65.2	49.9
4	S	F 4	62.5	54.6	10	N	F 3	66.3	56.0
4	S	F 5	62.6	54.5	10	N	F 4	66.3	55.9
4	S	F 6	62.6	54.4	10	N	F 5	66.1	55.8
4	S	F 7	62.5	54.2	10	N	F 6	66.0	55.7
4	S	F 8	62.4	54.0	10	N	F 7	65.9	55.6
4	S	F 9	62.3	53.7	10	N	F 8	65.7	55.4
4	S	F 10	62.2	53.5	10	N	F 9	65.6	55.3
5	S	F 3	62.2	54.7	10	N	F 10	65.5	55.2
5	S	F 4	62.3	54.6	10	N	F 11	65.4	55.1
5	S	F 5	62.2	54.4	11	N	F 3	67.1	56.7
5	S	F 6	62.2	54.2	11	N	F 4	67.0	56.6
5	S	F 7	62.2	54.0	11	N	F 5	66.9	56.5
5	S	F 8	62.1	53.7	11	N	F 6	66.8	56.4
5	S	F 9	61.9	53.5	11	N	F 7	66.6	56.3
5	S	F 10	61.8	53.3	11	N	F 8	66.5	56.1
6	E	F 3	47.6	39.7	11	N	F 9	66.3	56.0
6	E	F 4	58.4	51.0	11	N	F 10	66.2	55.9
6	E	F 5	58.8	51.4	11	N	F 11	66.1	55.8
6	E	F 6	58.4	51.1					
6	E	F 7	58.1	50.7					
6	E	F 8	57.8	50.3					
6	E	F 9	57.5	50.0					
6	E	F 10	57.4	49.9					

Note - First Floor (F 1) and Second Floor (F 2) are covered in the "Main Base Building"

West Tower									
Receptor Number	Façade Direction	Floor	Future Situation		Receptor Number	Façade Direction	Floor	Future Situation	
			Daytime Leq,16hr	Night Time Leq,8hr				Daytime Leq,16hr	Night Time Leq,8hr
1	N	F 3	69.4	58.9	3	W	F 16	68.8	58.5
1	N	F 4	69.3	58.8	3	W	F 17	68.6	58.3
1	N	F 5	69.1	58.6	3	W	F 18	68.4	58.1
1	N	F 6	68.9	58.4	3	W	F 19	68.3	58.0
1	N	F 7	68.7	58.2	3	W	F 20	68.1	57.8
1	N	F 8	68.5	58.0	3	W	F 21	67.9	57.7
1	N	F 9	68.3	57.9	3	W	F 22	67.8	57.5
1	N	F 10	68.1	57.7	4	W	F 3	71.4	61.0
1	N	F 11	67.8	57.4	4	W	F 4	71.1	60.7
1	N	F 12	67.6	57.2	4	W	F 5	70.9	60.5
1	N	F 13	67.4	57.1	4	W	F 6	70.6	60.3
1	N	F 14	67.3	56.9	4	W	F 7	70.3	60.0
1	N	F 15	67.1	56.7	4	W	F 8	70.1	59.8
1	N	F 16	66.9	56.5	4	W	F 9	69.9	59.6
1	N	F 17	66.7	56.4	4	W	F 10	69.7	59.4
1	N	F 18	66.5	56.2	4	W	F 11	69.5	59.2
1	N	F 19	66.4	56.1	5	S	F 3	65.5	56.5
1	N	F 20	66.3	56.0	5	S	F 4	65.6	56.5
1	N	F 21	66.1	55.8	5	S	F 5	65.3	56.3
1	N	F 22	60.2	50.3	5	S	F 6	65.1	56.1
1	N	F 23	63.7	53.6	5	S	F 7	64.9	55.8
2	N	F 3	69.9	59.4	5	S	F 8	64.7	55.6
2	N	F 4	69.7	59.2	5	S	F 9	64.5	55.3
2	N	F 5	69.5	59.0	5	S	F 10	64.4	55.0
2	N	F 6	69.3	58.8	5	S	F 11	64.2	54.8
2	N	F 7	69.1	58.6	6	S	F 12	52.1	42.8
2	N	F 8	68.9	58.4	6	S	F 13	59.8	50.0
2	N	F 9	68.6	58.2	6	S	F 14	60.7	51.2
2	N	F 10	68.4	58.0	6	S	F 15	61.4	52.1
2	N	F 11	68.2	57.7	6	S	F 16	61.8	52.5
2	N	F 12	67.9	57.5	6	S	F 17	62.2	52.9
2	N	F 13	67.7	57.3	6	S	F 18	62.6	53.2
2	N	F 14	67.5	57.1	6	S	F 19	62.7	53.2
2	N	F 15	67.3	56.9	6	S	F 20	62.7	53.2
2	N	F 16	67.1	56.8	6	S	F 21	62.7	53.1
2	N	F 17	67.0	56.6	6	S	F 22	62.7	53.0
2	N	F 18	66.9	56.5	7	S	F 23	56.0	46.4
2	N	F 19	66.8	56.4	8	S	F 12	53.0	43.6
2	N	F 20	66.6	56.3	8	S	F 13	60.1	50.3
2	N	F 21	66.5	56.2	8	S	F 14	63.2	53.3
2	N	F 22	66.4	56.1	8	S	F 15	63.8	53.9
3	W	F 3	71.7	61.2	8	S	F 16	63.8	54.0
3	W	F 4	71.5	61.0	8	S	F 17	63.8	54.0
3	W	F 5	71.2	60.8	8	S	F 18	63.7	53.9
3	W	F 6	71.0	60.5	8	S	F 19	63.5	53.8
3	W	F 7	70.7	60.3	8	S	F 20	63.4	53.6
3	W	F 8	70.5	60.1	8	S	F 21	48.4	40.3
3	W	F 9	70.3	59.9	9	S	F 3	46.7	38.5
3	W	F 10	70.0	59.7	9	S	F 4	52.1	44.1
3	W	F 11	69.8	59.5	9	S	F 5	56.5	48.9
3	W	F 12	69.6	59.3	9	S	F 6	57.4	49.8
3	W	F 13	69.4	59.1	9	S	F 7	57.3	49.6
3	W	F 14	69.2	58.9	9	S	F 8	57.1	49.4
3	W	F 15	69.0	58.7	9	S	F 9	56.9	49.2

West Tower (Continued)									
Receptor Number	Façade Direction	Floor	Future Situation		Receptor Number	Façade Direction	Floor	Future Situation	
			Daytime Leq,16hr	Night Time Leq,8hr				Daytime Leq,16hr	Night Time Leq,8hr
9	S	F 10	56.7	48.9	11	E	F 11	53.2	43.7
9	S	F 11	56.6	48.7	11	E	F 12	56.9	47.2
9	S	F 12	56.6	48.6	11	E	F 13	58.7	48.9
9	S	F 13	57.9	49.4	11	E	F 14	59.1	49.4
9	S	F 14	59.9	50.9	11	E	F 15	59.2	49.7
9	S	F 15	60.2	51.1	11	E	F 16	59.2	49.7
9	S	F 16	60.3	51.1	11	E	F 17	59.1	49.7
9	S	F 17	60.3	51.1	11	E	F 18	59.0	49.5
9	S	F 18	60.3	51.1	11	E	F 19	58.9	49.4
9	S	F 19	60.3	51.1	11	E	F 20	58.8	49.4
9	S	F 20	60.3	51.0	11	E	F 21	58.7	49.3
9	S	F 21	60.3	51.0	11	E	F 22	58.6	49.3
9	S	F 22	60.3	51.0					
9	S	F 23	60.4	51.0					
10	E	F 11	44.7	36.5					
10	E	F 12	50.5	43.0					
10	E	F 13	53.2	45.6					
10	E	F 14	54.0	46.1					
10	E	F 15	54.8	46.6					
10	E	F 16	55.8	47.4					
10	E	F 17	56.7	48.0					
10	E	F 18	57.5	48.6					
10	E	F 19	57.8	48.9					
10	E	F 20	57.9	48.9					
10	E	F 21	57.9	48.9					
10	E	F 22	57.9	48.8					
10	E	F 23	57.9	48.9					

Appendix 4 - Minimum Sound Reduction from the Façade (window) to meet BS 8233, WHO and
Local Council Policy Internal Noise levels

APPENDIX 4

Calculated Façade Noise Levels within the Development and the Minimum Sound Reduction of the Façade to achieve Internal Noise Levels to BS 8233, WHO and Local Authority Guidelines

Main Base Building							Internal Noise Levels (WHO & BS 8233)		
Receptor Number	Façade Direction	Floor	Future Situation		Minimum Sound Reduction (R _w) to achieve Internal Noise levels		30		Bedroom
			Daytime	Night Time			35		Livingroom
			Leq,16hr	Leq,8hr	Day	Night	Recommended Window		SRI
1	N	2	65.4	55.2	30	25	6/12/6	Sealed Unit	33
1	N	3	65.3	55.0	30	25	6/12/6	Sealed Unit	33
2	N	2	66.0	55.7	31	26	6/12/6	Sealed Unit	33
2	N	3	65.9	55.6	31	26	6/12/6	Sealed Unit	33
3	N	2	66.2	55.9	31	26	6/12/6	Sealed Unit	33
3	N	3	66.3	56.0	31	26	6/12/6	Sealed Unit	33
4	E	2	55.9	47.4	21	17	6/12/6	Sealed Unit	33
4	E	3	59.1	51.1	24	21	6/12/6	Sealed Unit	33
5	E	2	57.8	48.9	23	19	6/12/6	Sealed Unit	33
5	E	3	59.2	50.5	24	21	6/12/6	Sealed Unit	33
6	E	2	60.0	50.6	25	21	6/12/6	Sealed Unit	33
6	E	3	61.0	51.6	24	20	6/12/6	Sealed Unit	33
7	N	2	66.6	56.3	32	26	6/12/6	Sealed Unit	33
7	N	3	66.7	56.4	32	26	6/12/6	Sealed Unit	33
8	S	2	53.8	46.2	19	16	6/12/11	Laminated	40
8	S	3	61.2	53.9	26	24	6/12/11	Laminated	40
9	N	2	66.1	55.8	31	26	6/12/6	Sealed Unit	33
9	N	3	66.4	56.0	31	26	6/12/6	Sealed Unit	33
10	N	2	66.9	56.6	32	27	6/12/6	Sealed Unit	33
10	N	3	67.1	56.7	32	27	6/12/6	Sealed Unit	33
Note 1 - Façade facing the railway line require mitigation during the night time to take into account the 45 dB L _{MAX} for a reasonable number of events (BOLD)									
Note 2 - the minimum sound reduction (R _w) required at east and north facing façade is for equivalent continuous sound level (L _{Aeq,16hr} and L _{Aeq,8hr})									

Calculated Facade Noise Levels within the Development and the Minimum Sound Reduction of the Facade to achieve Internal Noise Levels to BS 8233, WHO and Local Authority Guidelines

Eastern Element							Internal Noise Levels (WHO & BS 8233)		
Receptor Number	Façade Direction	Floor	Future Situation		Minimum Sound Reduction (R _w) to achieve Internal Noise levels		30	Bedroom	
			Daytime	Night Time			35	Livingroom	
			Leq,16hr	Leq,8hr			Day	Night	Recommended Window
1	S	3	62.1	54.7	27	25	6/12/11 Laminated	40	
1	S	4	61.9	54.5	27	25	6/12/11 Laminated	40	
1	S	5	61.6	54.1	27	24	6/12/11 Laminated	40	
1	S	6	61.3	53.7	26	24	6/12/11 Laminated	40	
1	S	7	61.0	53.3	26	23	6/12/11 Laminated	40	
1	S	8	60.7	52.9	26	23	6/12/11 Laminated	40	
1	S	9	60.6	52.6	26	23	6/12/11 Laminated	40	
1	S	10	60.3	52.3	25	22	6/12/11 Laminated	40	
1	S	11	58.0	49.6	23	20	6/12/11 Laminated	40	
1	S	12	57.7	49.3	23	20	6/12/11 Laminated	40	
2	E	3	60.1	52.1	25	22	6/12/6 Sealed Unit	33	
2	E	4	60.2	52.2	25	22	6/12/6 Sealed Unit	33	
2	E	5	60.0	52.0	25	22	6/12/6 Sealed Unit	33	
2	E	6	59.8	51.7	25	22	6/12/6 Sealed Unit	33	
2	E	7	59.6	51.5	25	22	6/12/6 Sealed Unit	33	
2	E	8	59.3	51.2	24	21	6/12/6 Sealed Unit	33	
2	E	9	59.1	50.9	24	21	6/12/6 Sealed Unit	33	
2	E	10	59.0	50.6	24	21	6/12/6 Sealed Unit	33	
2	E	11	58.9	50.5	24	21	6/12/6 Sealed Unit	33	
2	E	12	58.8	50.4	24	21	6/12/6 Sealed Unit	33	
3	E	3	60.1	51.5	25	22	6/12/6 Sealed Unit	33	
3	E	4	60.0	51.5	25	22	6/12/6 Sealed Unit	33	
3	E	5	59.9	51.4	25	21	6/12/6 Sealed Unit	33	
3	E	6	59.7	51.2	25	21	6/12/6 Sealed Unit	33	
3	E	7	59.6	51.1	25	21	6/12/6 Sealed Unit	33	
3	E	8	59.5	50.9	24	21	6/12/6 Sealed Unit	33	
3	E	9	59.5	50.8	24	21	6/12/6 Sealed Unit	33	
3	E	10	59.5	50.8	25	21	6/12/6 Sealed Unit	33	
3	E	11	59.5	50.8	25	21	6/12/6 Sealed Unit	33	
3	E	12	59.4	50.7	25	21	6/12/6 Sealed Unit	33	
4	E	3	60.9	51.7	26	22	6/12/6 Sealed Unit	33	
4	E	4	60.8	51.7	26	22	6/12/6 Sealed Unit	33	
4	E	5	60.7	51.6	26	22	6/12/6 Sealed Unit	33	
4	E	6	60.5	51.5	26	22	6/12/6 Sealed Unit	33	
4	E	7	60.6	51.5	26	22	6/12/6 Sealed Unit	33	
4	E	8	60.7	51.6	26	22	6/12/6 Sealed Unit	33	
4	E	9	60.9	51.7	26	22	6/12/6 Sealed Unit	33	
4	E	10	60.8	51.6	26	22	6/12/6 Sealed Unit	33	
4	E	11	60.7	51.5	26	22	6/12/6 Sealed Unit	33	
4	E	12	60.6	51.4	26	22	6/12/6 Sealed Unit	33	
Note 1 - Façade facing the railway line require mitigation during the night time to take into account the 45 dB L _{MAX} for a reasonable number of events (BOLD)									
Note 2 - the minimum sound reduction (R _w) required at east and north facing façade is for equivalent continuous sound level (L _{Aeq,16hr} and L _{Aeq,8hr})									

Calculated Facade Noise Levels within the Development and the Minimum Sound Reduction of the Facade to achieve Internal Noise Levels to BS 8233, WHO and Local Authority Guidelines

Eastern Element (Cont.)							Internal Noise Levels (WHO & BS 8233)		
Receptor Number	Façade Direction	Floor	Future Situation		Minimum Sound Reduction (R _w) to achieve Internal Noise levels		Recommended Window	SRI	
			Daytime	Night Time					
			Leq,16hr	Leq,8hr	Day	Night			
5	N	3	65.0	54.7	30	25	6/12/6	Sealed Unit	33
5	N	4	64.8	54.6	30	25	6/12/6	Sealed Unit	33
5	N	5	64.7	54.5	30	25	6/12/6	Sealed Unit	33
5	N	6	64.6	54.4	30	24	6/12/6	Sealed Unit	33
5	N	7	64.4	54.2	29	24	6/12/6	Sealed Unit	33
5	N	8	64.2	54.0	29	24	6/12/6	Sealed Unit	33
5	N	9	63.9	53.8	29	24	6/12/6	Sealed Unit	33
5	N	10	55.2	45.7	20	16	6/12/6	Sealed Unit	33
5	N	11	60.4	50.5	25	21	6/12/6	Sealed Unit	33
5	N	12	60.1	50.2	25	21	6/12/6	Sealed Unit	33
6	N	3	65.7	55.4	31	25	6/12/6	Sealed Unit	33
6	N	4	65.6	55.3	31	25	6/12/6	Sealed Unit	33
6	N	5	65.5	55.2	30	25	6/12/6	Sealed Unit	33
6	N	6	65.3	55.0	30	25	6/12/6	Sealed Unit	33
6	N	7	65.1	54.8	30	25	6/12/6	Sealed Unit	33
6	N	8	64.9	54.6	30	25	6/12/6	Sealed Unit	33
6	N	9	64.7	54.5	30	25	6/12/6	Sealed Unit	33
6	N	10	64.5	54.3	30	24	6/12/6	Sealed Unit	33
6	N	11	58.5	48.7	24	19	6/12/6	Sealed Unit	33
6	N	12	58.2	48.5	23	19	6/12/6	Sealed Unit	33
7	W	3	48.9	40.3	14	10	6/12/6	Sealed Unit	33
7	W	4	54.7	46.5	20	17	6/12/6	Sealed Unit	33
7	W	5	58.1	50.4	23	20	6/12/6	Sealed Unit	33
7	W	6	58.2	50.5	23	21	6/12/6	Sealed Unit	33
7	W	7	58.3	50.4	23	20	6/12/6	Sealed Unit	33
7	W	8	58.3	50.2	23	20	6/12/6	Sealed Unit	33
7	W	9	58.3	50.1	23	20	6/12/6	Sealed Unit	33
7	W	10	58.3	50.0	23	20	6/12/6	Sealed Unit	33
7	W	11	58.4	50.0	23	20	6/12/6	Sealed Unit	33
7	W	12	58.3	49.9	23	20	6/12/6	Sealed Unit	33

Note 1 - the minimum sound reduction (R_W) required at north and west facing façade is for equivalent continuous sound level (L_{Aeq,16hr} and L_{Aeq,8hr})

Note 1 - the minimum sound reduction (R_w) required at north and west facing façade is for equivalent continuous sound level (L_{Aeq,16hr} and L_{Aeq,8hr})

Calculated Façade Noise Levels within the Development and the Minimum Sound Reduction of the Façade to achieve Internal Noise Levels to BS 8233, WHO and Local Authority Guidelines

Central Element							Internal Noise Levels (WHO & BS 8233)		
Receptor Number	Façade Direction	Floor	Future Situation		Minimum Sound Reduction (Rw) to achieve Internal Noise levels		Recommended Window	SRI	
			Daytime	Night Time					
			Leq,16hr	Leq,8hr	Day	Night			
1	S	3	49.4	40.7	14	11	6/12/6 Sealed Unit	33	
1	S	4	54.9	46.2	20	16	6/12/6 Sealed Unit	33	
1	S	5	58.5	50.4	23	20	6/12/6 Sealed Unit	33	
1	S	6	59.6	51.5	25	22	6/12/6 Sealed Unit	33	
1	S	7	59.8	51.6	25	22	6/12/6 Sealed Unit	33	
1	S	8	59.9	51.5	25	22	6/12/6 Sealed Unit	33	
1	S	9	60.0	51.5	25	22	6/12/6 Sealed Unit	33	
1	S	10	60.0	51.4	25	21	6/12/6 Sealed Unit	33	
1	S	11	60.0	51.4	25	21	6/12/6 Sealed Unit	33	
2	W	3	49.0	40.3	14	10	6/12/6 Sealed Unit	33	
2	W	4	54.8	46.2	20	16	6/12/6 Sealed Unit	33	
2	W	5	57.9	49.8	23	20	6/12/6 Sealed Unit	33	
2	W	6	58.7	50.5	24	21	6/12/6 Sealed Unit	33	
2	W	7	58.9	50.6	24	21	6/12/6 Sealed Unit	33	
2	W	8	59.1	50.6	24	21	6/12/6 Sealed Unit	33	
2	W	9	59.2	50.6	24	21	6/12/6 Sealed Unit	33	
2	W	10	59.3	50.6	24	21	6/12/6 Sealed Unit	33	
2	W	11	59.3	50.6	24	21	6/12/6 Sealed Unit	33	
3	W	3	51.2	42.5	16	13	6/12/6 Sealed Unit	33	
3	W	4	60.2	52.4	25	22	6/12/6 Sealed Unit	33	
3	W	5	61.0	52.8	26	23	6/12/6 Sealed Unit	33	
3	W	6	61.2	52.8	26	23	6/12/6 Sealed Unit	33	
3	W	7	61.3	52.8	26	23	6/12/6 Sealed Unit	33	
3	W	8	61.4	52.7	26	23	6/12/6 Sealed Unit	33	
3	W	9	61.4	52.6	26	23	6/12/6 Sealed Unit	33	
3	W	10	61.4	52.6	26	23	6/12/6 Sealed Unit	33	
4	S	3	62.3	54.5	27	25	6/12/11 Laminated	40	
4	S	4	62.5	54.6	27	25	6/12/11 Laminated	40	
4	S	5	62.6	54.5	28	25	6/12/11 Laminated	40	
4	S	6	62.6	54.4	28	24	6/12/11 Laminated	40	
4	S	7	62.5	54.2	27	24	6/12/11 Laminated	40	
4	S	8	62.4	54.0	27	24	6/12/11 Laminated	40	
4	S	9	62.3	53.7	27	24	6/12/11 Laminated	40	
4	S	10	62.2	52.6	27	24	6/12/11 Laminated	40	
5	S	3	62.2	54.7	27	25	6/12/11 Laminated	40	
5	S	4	62.3	54.6	27	25	6/12/11 Laminated	40	
5	S	5	62.2	54.4	27	24	6/12/11 Laminated	40	
5	S	6	62.2	54.2	27	24	6/12/11 Laminated	40	
5	S	7	62.2	54.0	27	24	6/12/11 Laminated	40	
5	S	8	62.1	53.7	27	24	6/12/11 Laminated	40	
5	S	9	61.9	53.5	27	24	6/12/11 Laminated	40	

Note 1 - Façade facing the railway line require mitigation during the night time to take into account the 45 dB L_{MAX} for a reasonable number of events (**BOLD**)

Note 2 - the minimum sound reduction (R_w) required at east and west facing façade is for equivalent continuous sound level (L_{Aeq,16hr} and L_{Aeq,8hr})

Note 3 - receptor 1 is to the rear of the third floor (F 3) roof terrace

Calculated Facade Noise Levels within the Development and the Minimum Sound Reduction of the Facade to achieve Internal Noise Levels to BS 8233, WHO and Local Authority Guidelines

Central Element (Cont.)							Internal Noise Levels (WHO & BS 8233)		
Receptor Number	Façade Direction	Floor	Future Situation		Minimum Sound Reduction (R _w) to achieve Internal Noise levels		Recommended Window	SRI	
			Daytime	Night Time					
			Leq,16hr	Leq,8hr					
					Day	Night			
6	E	3	47.6	39.7	13	10	6/12/6	Sealed Unit	33
6	E	4	58.4	51.0	23	21	6/12/6	Sealed Unit	33
6	E	5	58.8	51.4	24	21	6/12/6	Sealed Unit	33
6	E	6	58.4	51.1	23	21	6/12/6	Sealed Unit	33
6	E	7	58.1	50.7	23	21	6/12/6	Sealed Unit	33
6	E	8	57.8	50.3	23	20	6/12/6	Sealed Unit	33
6	E	9	57.5	50.0	23	20	6/12/6	Sealed Unit	33
6	E	10	57.4	49.9	23	20	6/12/6	Sealed Unit	33
7	E	3	46.1	37.8	11	8	6/12/6	Sealed Unit	33
7	E	4	50.5	42.2	15	12	6/12/6	Sealed Unit	33
7	E	5	54.7	47.2	20	17	6/12/6	Sealed Unit	33
7	E	6	56.4	49.0	21	19	6/12/6	Sealed Unit	33
7	E	7	56.3	48.8	21	19	6/12/6	Sealed Unit	33
7	E	8	56.1	48.6	21	19	6/12/6	Sealed Unit	33
7	E	9	55.9	48.3	21	18	6/12/6	Sealed Unit	33
7	E	10	55.8	48.1	21	18	6/12/6	Sealed Unit	33
7	E	11	55.7	48.0	21	18	6/12/6	Sealed Unit	33
8	S	3	48.0	39.4	13	9	6/12/6	Sealed Unit	33
8	S	4	52.7	43.9	18	14	6/12/6	Sealed Unit	33
8	S	5	55.6	47.5	21	18	6/12/6	Sealed Unit	33
8	S	6	57.8	49.9	23	20	6/12/6	Sealed Unit	33
8	S	7	58.1	50.2	23	20	6/12/6	Sealed Unit	33
8	S	8	58.1	50.1	23	20	6/12/6	Sealed Unit	33
8	S	9	58.1	50.0	23	20	6/12/6	Sealed Unit	33
8	S	10	58.0	49.8	23	20	6/12/6	Sealed Unit	33
8	S	11	57.9	49.7	23	20	6/12/6	Sealed Unit	33
9	N	3	66.2	55.9	31	26	6/12/6	Sealed Unit	33
9	N	4	66.1	55.8	31	26	6/12/6	Sealed Unit	33
9	N	5	65.9	55.6	31	26	6/12/6	Sealed Unit	33
9	N	6	65.8	55.5	31	26	6/12/6	Sealed Unit	33
9	N	7	65.7	55.4	31	25	6/12/6	Sealed Unit	33
9	N	8	65.5	55.2	30	25	6/12/6	Sealed Unit	33
9	N	9	65.4	55.1	30	25	6/12/6	Sealed Unit	33
9	N	10	65.3	55.0	30	25	6/12/6	Sealed Unit	33
9	N	11	65.2	49.9	30	25	6/12/6	Sealed Unit	33
10	N	3	66.3	56.0	31	26	6/12/6	Sealed Unit	33
10	N	4	66.3	55.9	31	26	6/12/6	Sealed Unit	33
10	N	5	66.1	55.8	31	26	6/12/6	Sealed Unit	33
10	N	6	66.0	55.7	31	26	6/12/6	Sealed Unit	33
10	N	7	65.9	55.6	31	26	6/12/6	Sealed Unit	33
10	N	8	65.7	55.4	31	25	6/12/6	Sealed Unit	33
10	N	9	65.6	55.3	31	25	6/12/6	Sealed Unit	33
10	N	10	65.5	55.2	30	25	6/12/6	Sealed Unit	33
10	N	11	65.4	55.1	30	25	6/12/6	Sealed Unit	33
Note 1 - the minimum sound reduction (R _w) required at east and north facing façade is for equivalent continuous sound level (L _{Aeq,16hr} and L _{Aeq,8hr})									
Note 2 - receptor 8 is to the rear of the third floor (F 3) roof terrace									

Calculated Facade Noise Levels within the Development and the Minimum Sound Reduction of the Facade to achieve Internal Noise Levels to BS 8233, WHO and Local Authority Guidelines

Central Element (Cont.)							Internal Noise Levels (WHO & BS 8233)		
Receptor Number	Façade Direction	Floor	Future Situation		Minimum Sound Reduction (R _w) to achieve Internal		30	Bedroom	SRI
			Daytime Leq,16hr	Night Time Leq,8hr			35	Livingroom	
							Day	Night	
11	N	3	67.1	56.7	32	27	6/12/6	Sealed Unit	33
11	N	4	67.0	56.6	32	27	6/12/6	Sealed Unit	33
11	N	5	66.9	56.5	32	27	6/12/6	Sealed Unit	33
11	N	6	66.8	56.4	32	26	6/12/6	Sealed Unit	33
11	N	7	66.6	56.3	32	26	6/12/6	Sealed Unit	33
11	N	8	66.5	56.1	31	26	6/12/6	Sealed Unit	33
11	N	9	66.3	56.0	31	26	6/12/6	Sealed Unit	33
11	N	10	66.2	55.9	31	26	6/12/6	Sealed Unit	33
11	N	11	66.1	55.8	31	26	6/12/6	Sealed Unit	33

Note 1 - the minimum sound reduction (R_w) required at east and north facing façade is for equivalent continuous sound level (L_{Aeq,16hr} and L_{Aeq,8hr})

Calculated Facade Noise Levels within the Development and the Minimum Sound Reduction of the Facade to achieve Internal Noise Levels to BS 8233, WHO and Local Authority Guidelines

West Tower							Internal Noise Levels (WHO & BS 8233)	
Receptor Number	Façade Direction	Floor	Future Situation		Minimum Sound Reduction (R _w) to achieve Internal Noise levels		30	Bedroom
			Daytime	Night Time			35	Livingroom
			Leq,16hr	Leq,8hr	Day	Night	Recommended Window	
1	N	F 3	69.398	58.9	34	29	4/12/12	Sealed Unit 36
1	N	F 4	69.2643	58.8	34	29	4/12/12	Sealed Unit 36
1	N	F 5	69.098	58.6	34	29	4/12/12	Sealed Unit 36
1	N	F 6	68.898	58.4	34	28	4/12/12	Sealed Unit 36
1	N	F 7	68.698	58.2	34	28	4/12/12	Sealed Unit 36
1	N	F 8	68.498	58	33	28	4/12/12	Sealed Unit 36
1	N	F 9	68.2643	57.9	33	28	4/12/12	Sealed Unit 36
1	N	F 10	68.0643	57.7	33	28	4/12/12	Sealed Unit 36
1	N	F 11	67.798	57.4	33	27	4/12/12	Sealed Unit 36
1	N	F 12	67.598	57.2	33	27	4/12/12	Sealed Unit 36
1	N	F 13	67.398	57.1	32	27	6/12/6	Sealed Unit 33
1	N	F 14	67.2643	56.9	32	27	6/12/6	Sealed Unit 33
1	N	F 15	67.0643	56.7	32	27	6/12/6	Sealed Unit 33
1	N	F 16	66.8643	56.5	32	27	6/12/6	Sealed Unit 33
1	N	F 17	66.6643	56.4	32	26	6/12/6	Sealed Unit 33
1	N	F 18	66.498	56.2	31	26	6/12/6	Sealed Unit 33
1	N	F 19	66.3643	56.1	31	26	6/12/6	Sealed Unit 33
1	N	F 20	66.2643	56	31	26	6/12/6	Sealed Unit 33
1	N	F 21	66.0643	55.8	31	26	6/12/6	Sealed Unit 33
1	N	F 22	60.2312	50.3	25	20	6/12/6	Sealed Unit 33
1	N	F 23	63.7312	53.6	29	24	6/12/6	Sealed Unit 33
2	N	F 3	69.898	59.4	35	29	4/12/12	Sealed Unit 36
2	N	F 4	69.698	59.2	35	29	4/12/12	Sealed Unit 36
2	N	F 5	69.498	59	34	29	4/12/12	Sealed Unit 36
2	N	F 6	69.298	58.8	34	29	4/12/12	Sealed Unit 36
2	N	F 7	69.098	58.6	34	29	4/12/12	Sealed Unit 36
2	N	F 8	68.8643	58.4	34	28	4/12/12	Sealed Unit 36
2	N	F 9	68.598	58.2	34	28	4/12/12	Sealed Unit 36
2	N	F 10	68.398	58	33	28	4/12/12	Sealed Unit 36
2	N	F 11	68.1643	57.7	33	28	4/12/12	Sealed Unit 36
2	N	F 12	67.898	57.5	33	28	4/12/12	Sealed Unit 36
2	N	F 13	67.698	57.3	33	27	4/12/12	Sealed Unit 36
2	N	F 14	67.498	57.1	32	27	6/12/6	Sealed Unit 33
2	N	F 15	67.298	56.9	32	27	6/12/6	Sealed Unit 33
2	N	F 16	67.098	56.8	32	27	6/12/6	Sealed Unit 33
2	N	F 17	66.9643	56.6	32	27	6/12/6	Sealed Unit 33
2	N	F 18	66.8643	56.5	32	27	6/12/6	Sealed Unit 33
2	N	F 19	66.7643	56.4	32	26	6/12/6	Sealed Unit 33
2	N	F 20	66.598	56.3	32	26	6/12/6	Sealed Unit 33
2	N	F 21	66.4643	56.2	31	26	6/12/6	Sealed Unit 33
2	N	F 22	66.3643	56.1	31	26	6/12/6	Sealed Unit 33

Note 1 - the minimum sound reduction (R_w) required at the north facing façade is for equivalent continuous sound level (L_{Aeq,16hr} and L_{Aeq,8hr})

Calculated Façade Noise Levels within the Development and the Minimum Sound Reduction of the Façade to achieve Internal Noise Levels to BS 8233, WHO and Local Authority Guidelines

West Tower (Cont.)							Internal Noise Levels (WHO & BS 8233)		Recommended Window	SRI
Receptor Number	Façade Direction	Floor	Future Situation		Minimum Sound Reduction (R _w) to achieve Internal Noise levels		30	Bedroom		
			Daytime	Night Time			35	Livingroom		
			Leq,16hr	Leq,8hr						
3	W	3	71.7	61.2	37	31	6/12/11	Laminated	40	
3	W	4	71.5	61.0	37	31	6/12/11	Laminated	40	
3	W	5	71.2	60.8	36	31	6/12/10	Sealed Unit	37	
3	W	6	71.0	60.5	36	31	6/12/10	Sealed Unit	37	
3	W	7	70.7	60.3	36	30	6/12/10	Sealed Unit	37	
3	W	8	70.5	60.1	36	30	6/12/10	Sealed Unit	37	
3	W	9	70.3	59.9	35	30	4/12/12	Sealed Unit	36	
3	W	10	70.0	59.7	35	30	4/12/12	Sealed Unit	36	
3	W	11	69.8	59.5	35	30	4/12/12	Sealed Unit	36	
3	W	12	69.6	59.3	35	29	4/12/12	Sealed Unit	36	
3	W	13	69.4	59.1	34	29	4/12/12	Sealed Unit	36	
3	W	14	69.2	58.9	34	29	4/12/12	Sealed Unit	36	
3	W	15	69.0	58.7	34	29	4/12/12	Sealed Unit	36	
3	W	16	68.8	58.5	34	29	4/12/12	Sealed Unit	36	
3	W	17	68.6	58.3	34	28	4/12/12	Sealed Unit	36	
3	W	18	68.4	58.1	33	28	4/12/12	Sealed Unit	36	
3	W	19	68.3	58.0	33	28	4/12/12	Sealed Unit	36	
3	W	20	68.1	57.8	33	28	4/12/12	Sealed Unit	36	
3	W	21	67.9	57.7	33	28	4/12/12	Sealed Unit	36	
3	W	22	67.8	57.5	33	28	4/12/12	Sealed Unit	36	
4	W	3	71.4	61.0	36	31	6/12/10	Sealed Unit	37	
4	W	4	71.1	60.7	36	31	6/12/10	Sealed Unit	37	
4	W	5	70.9	60.5	36	31	6/12/10	Sealed Unit	37	
4	W	6	70.6	60.3	36	30	6/12/10	Sealed Unit	37	
4	W	7	70.3	60.0	35	30	4/12/12	Sealed Unit	36	
4	W	8	70.1	59.8	35	30	4/12/12	Sealed Unit	36	
4	W	9	69.9	59.6	35	30	4/12/12	Sealed Unit	36	
4	W	10	69.7	59.4	35	29	4/12/12	Sealed Unit	36	
4	W	11	69.5	59.2	35	29	4/12/12	Sealed Unit	36	
5	S	3	65.5	56.5	30	27	6/12/11	Laminated	40	
5	S	4	65.6	56.5	31	27	6/12/11	Laminated	40	
5	S	5	65.3	56.3	30	26	6/12/11	Laminated	40	
5	S	6	65.1	56.1	30	26	6/12/11	Laminated	40	
5	S	7	64.9	55.8	30	26	6/12/11	Laminated	40	
5	S	8	64.7	55.6	30	26	6/12/11	Laminated	40	
5	S	9	64.5	55.3	30	25	6/12/11	Laminated	40	
5	S	10	64.4	55.0	29	25	6/12/11	Laminated	40	
5	S	11	64.2	54.8	29	25	6/12/11	Laminated	40	
6	S	12	52.1	42.8	17	13	6/12/10	Sealed Unit	37	
6	S	13	59.8	50.0	25	20	6/12/10	Sealed Unit	37	
6	S	14	60.7	51.2	26	21	4/12/12	Sealed Unit	36	
6	S	15	61.4	52.1	26	22	4/12/12	Sealed Unit	36	
6	S	16	61.8	52.5	27	23	4/12/12	Sealed Unit	36	
6	S	17	62.2	52.9	27	23	4/12/12	Sealed Unit	36	
6	S	18	62.6	53.2	28	23	4/12/12	Sealed Unit	36	
6	S	19	62.7	53.2	28	23	6/12/6	Sealed Unit	33	
6	S	20	62.7	53.2	28	23	6/12/6	Sealed Unit	33	
6	S	21	62.7	53.1	28	23	6/12/6	Sealed Unit	33	
6	S	22	62.7	53.0	28	23	6/12/6	Sealed Unit	33	
7	S	23	56.0	46.4	21	16	6/12/6	Sealed Unit	33	

Note 1 - Façade facing the railway line require mitigation during the night time to take into account the 45 dB L_{MAX} for a reasonable number of events (**BOLD**)

Note 2 - the minimum sound reduction (R_w) required at west facing façade is for equivalent continuous sound level (L_{Aeq,16hr} and L_{Aeq,8hr})

Note 1 - Façade facing the railway line require mitigation during the night time to take into account the 45 dB L_{MAX} for a reasonable number of events (**BOLD**)

Note 2 - the minimum sound reduction (R_w) required at west facing façade is for equivalent continuous sound level (L_{Aeq,16hr} and L_{Aeq,8hr})

Calculated Façade Noise Levels within the Development and the Minimum Sound Reduction of the Façade to achieve Internal Noise Levels to BS 8233, WHO and Local Authority Guidelines

West Tower (Cont.)							Internal Noise Levels (WHO & BS 8233)		
Receptor Number	Façade Direction	Floor	Future Situation		Minimum Sound Reduction (R _w) to achieve Internal Noise levels		30		SRI
			Daytime	Night Time			Bedroom		
			Leq,16hr	Leq,8hr	35	Livingroom			
8	S	12	53.0	43.6	18	14	4/12/12	Sealed Unit	36
8	S	13	60.1	50.3	25	20	4/12/12	Sealed Unit	36
8	S	14	63.2	53.3	28	23	4/12/12	Sealed Unit	36
8	S	15	63.8	53.9	29	24	4/12/12	Sealed Unit	36
8	S	16	63.8	54.0	29	24	4/12/12	Sealed Unit	36
8	S	17	63.8	54.0	29	24	4/12/12	Sealed Unit	36
8	S	18	63.7	53.9	29	24	4/12/12	Sealed Unit	36
8	S	19	63.5	53.8	28	24	4/12/12	Sealed Unit	36
8	S	20	63.4	53.6	28	24	4/12/12	Sealed Unit	36
8	S	21	48.4	40.3	13	10	4/12/12	Sealed Unit	36
9	S	3	46.7	38.5	12	9	6/12/6	Sealed Unit	33
9	S	4	52.1	44.1	17	14	6/12/6	Sealed Unit	33
9	S	5	56.5	48.9	22	19	6/12/6	Sealed Unit	33
9	S	6	57.4	49.8	22	20	6/12/6	Sealed Unit	33
9	S	7	57.3	49.6	22	20	6/12/6	Sealed Unit	33
9	S	8	57.1	49.4	22	19	6/12/6	Sealed Unit	33
9	S	9	56.9	49.2	22	19	6/12/6	Sealed Unit	33
9	S	10	56.7	48.9	22	19	6/12/6	Sealed Unit	33
9	S	11	56.6	48.7	22	19	6/12/6	Sealed Unit	33
9	S	12	56.6	48.6	22	19	6/12/6	Sealed Unit	33
9	S	13	57.9	49.4	23	19	6/12/6	Sealed Unit	33
9	S	14	59.9	50.9	25	21	6/12/6	Sealed Unit	33
9	S	15	60.2	51.1	25	21	6/12/6	Sealed Unit	33
9	S	16	60.3	51.1	25	21	6/12/6	Sealed Unit	33
9	S	17	60.3	51.1	25	21	6/12/6	Sealed Unit	33
9	S	18	60.3	51.1	25	21	6/12/6	Sealed Unit	33
9	S	19	60.3	51.1	25	21	6/12/6	Sealed Unit	33
9	S	20	60.3	51.0	25	21	6/12/6	Sealed Unit	33
9	S	21	60.3	51.0	25	21	6/12/6	Sealed Unit	33
9	S	22	60.3	51.0	25	21	6/12/6	Sealed Unit	33
9	S	23	60.4	51.0	25	21	6/12/6	Sealed Unit	33
10	E	11	44.7	36.5	10	7	6/12/6	Sealed Unit	33
10	E	12	50.5	43.0	16	13	6/12/6	Sealed Unit	33
10	E	13	53.2	45.6	18	16	6/12/6	Sealed Unit	33
10	E	14	54.0	46.1	19	16	6/12/6	Sealed Unit	33
10	E	15	54.8	46.6	20	17	6/12/6	Sealed Unit	33
10	E	16	55.8	47.4	21	17	6/12/6	Sealed Unit	33
10	E	17	56.7	48.0	22	18	6/12/6	Sealed Unit	33
10	E	18	57.5	48.6	23	19	6/12/6	Sealed Unit	33
10	E	19	57.8	48.9	23	19	6/12/6	Sealed Unit	33
10	E	20	57.9	48.9	23	19	6/12/6	Sealed Unit	33
10	E	21	57.9	48.9	23	19	6/12/6	Sealed Unit	33
10	E	22	57.9	48.8	23	19	6/12/6	Sealed Unit	33
10	E	23	57.9	48.9	23	19	6/12/6	Sealed Unit	33
Note 1 - Façade facing the railway line require mitigation during the night time to take into account the 45 dB L _{MAX} for a reasonable number of events (BOLD)									
Note 2 - receptor 9 is to the rear of the third floor (F 3) roof terrace									
Note 3 - the minimum sound reduction (R _w) required at east facing façade is for equivalent continuous sound level (L _{Aeq,16hr} and L _{Aeq,8hr})									

Calculated Façade Noise Levels within the Development and the Minimum Sound Reduction of the Façade to achieve Internal Noise Levels to BS 8233, WHO and Local Authority Guidelines

West Tower (Cont.)							Internal Noise Levels (WHO & BS 8233)	
Receptor Number	Façade Direction	Floor	Future Situation		Minimum Sound Reduction (R _w) to achieve Internal Noise levels		30	Bedroom
			Daytime	Night Time			35	Livingroom
			Leq,16hr	Leq,8hr	Day	Night	Recommended Window	
11	E	11	53.2	43.7	18	14	6/12/6	Sealed Unit 33
11	E	12	56.9	47.2	22	17	6/12/6	Sealed Unit 33
11	E	13	58.7	48.9	24	19	6/12/6	Sealed Unit 33
11	E	14	59.1	49.4	24	19	6/12/6	Sealed Unit 33
11	E	15	59.2	49.7	24	20	6/12/6	Sealed Unit 33
11	E	16	59.2	49.7	24	20	6/12/6	Sealed Unit 33
11	E	17	59.1	49.7	24	20	6/12/6	Sealed Unit 33
11	E	18	59.0	49.5	24	20	6/12/6	Sealed Unit 33
11	E	19	58.9	49.4	24	19	6/12/6	Sealed Unit 33
11	E	20	58.8	49.4	24	19	6/12/6	Sealed Unit 33
11	E	21	58.7	49.3	24	19	6/12/6	Sealed Unit 33
11	E	22	58.6	49.3	24	19	6/12/6	Sealed Unit 33
Note 3 - the minimum sound reduction (R _w) required at east facing façade is for equivalent continuous sound level (L _{Aeq,16hr} and L _{Aeq,8hr})								

With a sealed window unit of 6/12/6 an SRI of 33 dB is achievable
A standard brick cavity wall construction has an SRI of approximately 55 dB

A sealed unit of 4/12/12 configuration has an approximate SRI of 36 dB
A sealed unit of 6/12/10 configuration has an approximate SRI of 37 dB
A Laminated glass unit of configuration 6/12/11 has an approximate SRI of 40 dB



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